

THE NATIONAL ENCYCLOPEDIA

EDITOR IN CHIEF

HENRY SUZZALLO, Ph.D., Sc.D., LL.D.

Professor of the Philosophy of Education in Columbia University (1909-1915)

President of the University of Washington (1915-1926)

Director of the National Advisory Committee on Education (1929-1931)

*President of the Carnegie Foundation for the
Advancement of Teaching*

EDITORIAL DIRECTOR

W. W. BEARDSLEY



VOLUME EIGHT

NEW YORK

R. F. COLLIER & SON COMPANY

COPYRIGHT 1932
P. F. COLLIER & SON COMPANY

COPYRIGHT 1933
P. F. COLLIER & SON COMPANY

ALL RIGHTS RESERVED

MANUFACTURED IN THE UNITED STATES OF AMERICA

The National Encyclopedia

CONTRIBUTORS · VOLUME EIGHT

- A.B.J.** ABIGAIL BROWN JOHNSON, A.B.
Author of articles on American birds, food fishes and trees.
- A.B.L.** ARNO BENEDICT LUCKHARDT, PH.D., M.D.
Professor of Physiology, University of Chicago, Discoverer of Ethylene Anesthesia.
- A.B.S.** ARLOW BURDETTE STOUT, PH.D.
Director of Laboratories, New York Botanical Garden.
- A.B.W.** ALBERT BENEDICT WOLFE, A.B., A.M., PH.D.
Professor of Economics and Chairman of the Department of Economics, Ohio State University.
- A.C.F.** ARNO CARL FIELDNER, B.Sc. in CHEM.E., CHEM. ENGR.
Chief Engineer, Experiment Stations Division, United States Bureau of Mines.
- A.C.W.** ALBERT CONSER WHITAKER, PH.D.
Professor of Economics, Stanford University.
- A.D.** AMBROGIO DONINI, PH.D.
Assistant Professor of Italian, Smith College; formerly Professor of Christianity, University of Rome.
- A.De.** ALBERT DEUTSCH, B.A.
Author of Articles on the History and Art of Ancient Egypt, Babylonia and Assyria, Persia and Phoenicia.
- A.E.R.B.** ARTHUR EDWARD ROMILLY BOAK, PH.D.
Professor of Ancient History, Chairman of the Department of History, University of Michigan.
- A.F.A.** ARTHUR FREDERICK ABT, S.B., M.D.
Instructor, Northwestern University Medical School, Division of Pediatrics; Attending Pediatrician, Michael Reese Hospital, Chicago.
- A.F.H.** ALFRED FABIAN HESS, B.A., M.D., Sc.D.
Children's Specialist; Recipient of John Scott Award, 1927, for devising a method of producing a vitamin factor in food by means of ultra-violet rays.
- A.F.L.** ARTHUR FLETCHER LUCAS, M.A., PH.D.
Associate Professor of Economics, Clark University.
- A.H.S.** ALFRED H. SWEET, A.B., A.M., PH.D.
Professor of European History, Washington and Jefferson College; Author of *A History of England*.
- A.I.W.** ALICE I. WRIGHT, A.B.
Technical Assistant, Beebe Bermuda Expedition.
- A.L.H.** ALBERT L. HENNE, PH.D.
Director of Research, Midgley Research Foundation, Chemical Department, Ohio State University.
- A.L.L.** ANNA LANE LINGELBACH, A.B., PH.D.
Lecturer in History, Bryn Mawr College; Professor of History, Temple University.
- A.L.R.** PRINCE ANDRE LOBANOV ROSTOVSKY.
Graduate Ecole Libre des Sciences Politiques, Paris; Lecturer in History, University of California; Lecturer at the Royal Institute of International Affairs, London, Stanford University, and the Institute of International Relations.
- A.P.W.** ARTHUR PRYOR WATTS, M.A.
Assistant Professor of History, University of Pennsylvania.
- A.R.F.** ARTHUR REX FORBUSH.
Vice-president and General Manager, Pistany Institute of America.
- A.S.** ALEXANDER SILVERMAN, PH.B., A.B., M.S., Sc.D.
Head of the Department of Chemistry, University of Pittsburgh, and Consultant on Glass.
- A.Se.** ALFRED SENN, PH.D.
Professor of Germanic and Indo-European Philology, University of Wisconsin.
- A.Sh.** ABRAHAM I. SHINEDLING, A.B., A.M.
Staff Revision and Research Editor, the *Standard Jewish Encyclopaedia*; Rabbi in American Jewish communities.
- A.S.H.** ALBERT SPEAR HITCHCOCK, B.S., M.Sc., D.Sc.
Principal Botanist in charge of Systematic Agronomy, United States Department of Agriculture, Bureau of Plant Industry.
- A.Z.** ANTHONY ZELENY, PH.D.
Professor of Physics, University of Minnesota; Author of *Elements of Electricity*.
- B.C.H.H.** BASIL COLEMAN HYATT HARVEY, A.B., M.D.
Professor of Anatomy and Dean of Medical Students, Division of Biological Science, University of Chicago.
- B.F.** BERNARD FANTUS, M.S., M.D.
Professor of Therapeutics, University of Illinois; Member, Revision Committee of the National Formulary, and the United States Pharmacopoeia.
- B.F.K.** BENJAMIN FREEMAN KINGSBURY, PH.D., M.D.
Professor of Histology and Embryology, Cornell University.
- B.G.** BENJAMIN GOLDBERG, M.D.
Associate Professor of Medicine, University of Illinois Medical School; Medical Director, Municipal Tuberculosis Sanitarium, Chicago.
- B.H.B.** BENJAMIN HAGGOTT BECKHART, M.A., PH.D.
Associate Professor of Banking, School of Business, Columbia University.
- B.M.** BROADUS MITCHELL, A.B., PH.D.
Associate Professor of Political Economy, Johns Hopkins University; Author of *The Industrial Revolution*.
- C.D.H.** CHARLES DEWITT HURD, B.S., PH.D.
Professor of Organic Chemistry, Northwestern University.
- C.E.F.** CHARLES EVAN FOWLER, M.C.E.
Construction Engineer of Bridges, Harbors and Foundations, notably The White Pass Arch, Alaska, and Tacoma (Washington) Foundations.
- C.E.Ma.** CHARLES EMANUEL MARTIN, B.A., M.A., PH.D.
Head of the Department of Political Science and of International Law, University of Washington.
- C.E.S.** CARL EMIL SEASHORE, PH.D., LL.D., Sc.D.
Dean of the Graduate College and Head of the Department of Psychology, State University of Iowa.
- C.E.W.** COLSTON ESTEY WARNE, A.B., M.A., PH.D.
Associate Professor of Economics, Amherst College.

- C.F.We.** CLIFTON FAIRCHILD WEIDLICH, B.A., LL.B.
Attorney; Member of the New York and Connecticut Bar Associations.
- C.G.M.** CHARLES G. METTLER, N.S., M.A.
Executive, Manufacturing Service, Ordnance Department, United States Army; Assistant Military Attaché, London; Professor of Ordnance and Gunnery, West Point Military Academy.
- C.H.Hu.** CHARLES HAYNES HUGHES.
Consulting Naval Architect, formerly Technical Aid and Senior Engineer, United States Shipping Board, New York
- C.H.L.** CONRAD H. LANZA.
Colonel, Field Artillery, United States Army, prepared all artillery plans for American armies in France, decorated by the United States with Distinguished Service Medal with two Silver citations.
- C.H.P.** CHESTER H. PENNING, A.B., B.Sc. in CHEM.E.
Engineer, Technical Sales Department, Tennessee Eastman Corporation, Kingsport, Tenn.
- C.H.Po.** CLIFFORD HILLHOUSE POPE, B.A.
Assistant Curator of Herpetology, American Museum of Natural History.
- C.L.A.** CARL LUCAS ALSBERG, B.A., M.A., M.D.
Director, Food Research Institute, Stanford University.
- C.L.D.** CHESTER LAURENS DAWES, S.B.
Associate Professor of Electrical Engineering, Harvard University; formerly Professor of Electrical Engineering, United States Naval Academy.
- C.R.C.** CLIFFORD ROTHWELL CARTER.
Textile Engineer; Honorman in flax spinning in city and guilds of London.
- C.R.D.** CHARLES RAYMOND DOWNS, Ph.B., Ph.D.
Vice-President and Consulting Chemical Engineer, Weiss & Downs, New York City.
- C.S.G.** C. STUART GAGER, Ph.D., Sc.D., Pd.D.
Director, Brooklyn Botanic Garden; President, National Institute of Social Sciences, 1932- .
- C.W.E.** CHARLES WALLIS EDMUNDS, A.B., M.D.
Professor of Materia Medica and Therapeutics, Medical School, University of Michigan; Member of the Committee of Revision of the United States Pharmacopoeia, 1910-30.
- C.W.L.** CHARLES WALTER LYTLE, M.E.
Director of Industrial Co-operation, New York University; Fellow of the Institute of Management.
- C.W.P.** CHARLES W. PORTER, B.A., M.A., Ph.D.
Acting Assistant Professor of History, University of Virginia, 1932-33; Franco-American Exchange Fellow, University of Lyons, France, 1928-29.
- D.S.R.** DANIEL SOMMER ROBINSON, A.M., B.D., Ph.D.
Professor and Head of the Department of Philosophy, Indiana University; Author of *Principles of Reasoning*.
- E.A.B.** EDWIN ARTHUR BURTT, A.B., B.D., Ph.D.
Professor of Philosophy, Cornell University, Author of *Metaphysical Foundations of Modern Physics and Religion in an Age of Science*.
- E.A.K.** EDWARD ALBERT KREGER, B.Sc.
Major General, United States Army, Retired; formerly Professor of Law, United States Military Academy, and Judge Advocate General of the United States Army
- E.A.S.** EDWARD A. STRECKER, A.M., M.D., F.A.C.P.
Professor of Psychiatry, Division of Mental Diseases, University of Pennsylvania.
- E.C.Br.** EDGAR CLAY BRITTON, A.B., Ph.D.
Assistant Director of Organic Research, Dow Chemical Co.
- E.D.B.** E. DOUGLAS BRANCH, Ph.D.
Research Associate, State Historical Society of Iowa.
- E.D.F.** EDWIN DANIELS FOWLE, B.T.E.
Associate Editor, *Textile World*.
- E.E.B.** EDWARD EZRA BAUER, B.S., M.S., C.E.
Assistant Professor of Civil Engineering, University of Illinois; Member of the American Society of Civil Engineers.
- E.E.W.** EDWARD E. WALL, C.E.
Consulting Engineer; Director, Public Utilities, St. Louis, Mo., 1925-26, Designer and Chief Construction Engineer of Waterworks' Project for St. Louis, 1923-26.
- E.F.C.** EARL F. CRUICKSHANK, A.B., Ph.D.
Assistant Professor of History, Vanderbilt University.
- E.H.H.** EDWARD HOWARD HATTON, B.L., M.D.
Professor of Pathology and Director of Graduate Courses, Northwestern University Dental School.
- E.I.** ERNEST INGERSOLL.
Editor of the Department of Natural History, *The Weekly Star*, Montreal.
- E.J.G.** EDWIN JAMES GIBBONS.
Textile Designer at the Hope Webbing Co., Pawtucket, R.I.; Instructor in Textile Design at the Samuel Slater Evening High School.
- E.J.M.** EDWARD JAMES MOORE, A.B., A.M., Ph.D.
Professor and Head of the Department of Physics, University of Buffalo, Member of the American Physical Society.
- E.M.D.** EDWIN MERRICK DODD, Jr., A.B., LL.B.
Professor of Law, Harvard Law School, formerly Professor of Law at the Universities of Nebraska and Chicago.
- E.M.Sy.** ERNEST M. SYMMES, S.B.
Chemical Engineer, Hercules Powder Co.
- E.R.L.** ERNEST RAYMOND LILLEY, B.S., M.S., Sc.D.
Professor of Economic Geology, New York University; Guggenheim Fellow, 1930-31.
- E.So.** ERWIN SOHN, B.Sc. in CHEM.E.
Director of Research, Standard Sanitary Manufacturing Co.
- E.V.A.** EDGAR V. ALLEN, B.Sc., M.D., M.A., M.Sc.
Instructor in Medicine, Division of Internal Medicine, Mayo Clinic and Foundation, Rochester, Minn.
- E.W.E.** EDWIN WILLIAM ELY, Ph.B., M.A.
Chief, Division of Simplified Practice, Bureau of Standards, United States Department of Commerce.
- E.W.G.** ELIZABETH W. GILBOY, A.B., M.A., Ph.D.
Secretary of Harvard University Committee on Economic Research; Graduate Adviser in Economics and Recipient of Travelling Fellowship from Radcliffe College, 1926-28.
- E.W.P.** ELBRIDGE W. PALMER.
President, Kingsport Press, Kingsport, Tenn.
- F.A.B.** FRED ASA BARNES, C.E., M.C.F.
Professor of Railroad Engineering, Cornell University.
- F.B.R.** FRANK BENJAMIN ROWLEY, B.S., M.E.
Professor of Mechanical Engineering and Director of Experimental Engineering Laboratories, University of Minnesota; Consulting Engineer for the State of Minnesota Securities Commission.
- F.C.L.** FLORENCE CLAUS LA FON.
Home Appliance Editor, *Electrical Merchandising*.
- F.E.J.** FREDERICK ERNEST JOHNSON, A.B., B.D., D.D.
Professor of Education, Teachers College, Columbia University, Executive Secretary, Department of Research and Education, Federal Council of Churches; Director of the International Survey of the Young Men's and Young Women's Christian Associations.
- F.E.S.** FELIX E. SCHELLING, LL.D., Litt.D.
Professor of English Literature, University of Pennsylvania.
- F.H.C.** FRED HERBERT COLVIN.
Editor of the *American Machinist*; Life Member, Franklin Institute.

- F.N.S.** FRANK NEWMAN SPELLER, B.A.Sc., D.Sc.
Director of Research Department of Metallurgy, National Tube Co., Pittsburgh; Franklin Institute Medalist.
- F.R.H.** FREDERIC R. HARRIS, M.E., D.E.
Rear Admiral, United States Navy, Retired; Consulting Engineer, Aldred Lecturer on Docks and Ports, Johns Hopkins University.
- F.S.C.** F. STUART CHAPIN, B.S., A.M., Ph.D.
Professor and Chairman of the Department of Sociology, University of Minnesota, formerly Professor of Sociology and Chairman of the Department of Economics and Sociology, Smith College.
- F.S.C.N.** F. S. C. NORTHROP, B.A., M.A., Ph.D.
Associate Professor of Philosophy, Yale University; Secretary-Treasurer, American Philosophical Association.
- F.S.P.** FRANCIS S. PHILBRICK, Ph.D., LL.B., LL.D.
Professor of Law, University of Pennsylvania; Translator of the German, Swiss, and Spanish sections of *A General Survey of Continental Legal History*, and of *Heubner's History of Germanic Private Law*.
- F.W.T.** FRED WILBUR TANNER, B.S., M.S., Ph.D.
Professor and Head of the Department of Bacteriology, University of Illinois; formerly Bacteriologist and Chemist, Special Sanitary Survey, Racine, Wis.
- G.A.O.** GEORGE A. ORROK, M.E.
Consulting Engineer, New York City; Member of the American Society of Mechanical Engineers, American Society of Civil Engineers.
- G.C.** GROVER CLARK, A.B., A.M.
Adviser on the Far East, Social Science Research Council, 1932-; Lecturer, Columbia University.
- G.E.F.** GABRIELLE ELLIOT FORBUSH, A.B.
Writer and Lecturer.
- G.E.G.C.** GEORGE E. G. CATLIN, M.A., Ph.D.
Assistant Professor of Politics, Cornell University; Chancellor's English Essayist, Oxford University, 1920; Lecturer in Medieval and Modern History, University of Sheffield, England, 1920-24.
- G.Hu.** GLENN HUGHES.
Professor of English and Head of the Division of the Drama, University of Washington.
- G.M.H.** GEORGE McLEAN HARPER, JR., M.A., Ph.D.
Assistant Professor of Latin, Yale University.
- G.M.J.** GRACE MARY JAFFE, M.A., Docteur de l'Université de Paris.
Research Assistant, Institute for Economic Research, Northwestern University; Member of the Social Science Research Council in Paris, 1926-27.
- G.R.N.** GEORGE RAPALL NOYES, Ph.D., Litt.D.
Professor of Slavic Languages, University of California.
- G.S.** GEORGE SOULE, A.B.
Editor, *The New Republic*.
- G.W.K.** GEORGE WALLACE KABLE, B.S. in C.E., M.S.
Director, National Rural Electric Project.
- G.W.M.** GEORGE WALKER MULLINS, Ph.D.
Professor of Mathematics, Barnard College, Columbia University.
- H.A.A.** HARRY A. AIKEN.
Journalist and Traveler.
- H.A.G.** HENRY ALLAN GLEASON, B.S., A.M., Ph.D.
Curator, New York Botanical Garden.
- H.D.L.** HAROLD DWIGHT LASSWELL, Ph.D.
Assistant Professor of Political Science, University of Chicago; Member of the Executive Council, American Political Science Association.
- H.E.B.** HARRY ELMER BARNES, A.B., A.M., Ph.D.
Professor of History and Sociology, Smith College; Member of the American Academy of Political and Social Science and the Royal Economic Society.
- H.E.K.R.** HENRY E. K. RUPPEL, A.B., A.M., B.S.
Chief Chemist and Metallurgist, Gillette Safety Razor Co.
- H.E.W.** HAROLD EDWARD WADELY.
President, Fifth Carpet Co.
- H.F.M.** HENRY FRANCOIS MULLER, Ph.D.
Professor of Romance Philology and Executive Director of the French Department, Columbia University.
- H.G.P.** HENRY GEORGE PONCHER, M.D.
Assistant Professor of Pediatrics, University of Illinois.
- H.H.** HERMANN HAGEDORN, A.B.
Writer and Executive Director of the Roosevelt Memorial Association; Member of The American Institute of Arts and Letters; Author of *The Boys' Life of Theodore Roosevelt*.
- H.J.M.** HORACE JAMES MACINTIRE, S.B., M.M.E.
Professor of Refrigeration, University of Illinois.
- H.L.L.** HARLEY LEIST LUTZ, A.B., A.M., Ph.D.
Professor of Public Finance, Department of Economics, Princeton University; President of the National Tax Association, 1927-28.
- H.L.S.** HARRY L. SHAPIRO, A.B., A.M., Ph.D.
Associate Curator of Physical Anthropology, American Museum of Natural History.
- H.McB.** HENRY MCBRIDE.
Editor, *Creative Art*; Art Critic of the *New York Sun*.
- H.M.H.** HENRY METCALF HOBART, B.S. in E.E.
Consulting Engineer, General Electric Co., First Vice-Director of the American Bureau of Welding.
- H.M.W.** HELEN M. WALKER, Ph.B., M.A., Ph.D.
Assistant Professor of Education, Teachers College, Columbia University.
- H.N.F.** HAROLD NORTH FOWLER, A.B., Ph.D.
Consultant, Classical Literature, Library of Congress; Professor of Greek Language and Literature, American School of Classical Studies, Athens, 1924-25.
- H.T.B.** HARRIET THOMPSON BARTO, A.B., A.M.
Assistant Professor of Dietetics, Department of Home Economics, University of Illinois.
- H.W.B.** H. W. BROOKS.
Consulting Fuels and Power Engineer; Consulting Engineer to the State of Ohio.
- H.W.L.** HARRY W. LAIDLER, Ph.D., LL.D.
Executive Director, League of Industrial Democracy; Author, Lecturer and Economist; President of the National Bureau of Economic Research.
- H.W.O.** HOWARD WASHINGTON ODUM, A.M., Ph.D.
Professor of Sociology, University of North Carolina; President of the American Sociological Society, 1930; Assistant Director of Research, President Hoover's Research Committee on Social Trends.
- I.C.G.** IRVINE C. GARDNER, A.B., A.M., Ph.D.
Physicist, United States Bureau of Standards.
- I.G.** ISAAC GOLDBERG, A.B., A.M., Ph.D.
Lecturer on Hispano-American Literature, Harvard University; Guggenheim Fellow, 1932-33.
- I.L.K.** ISAAC L. KANDEL, M.A., Ph.D.
Professor of Education and Associate International Instructor in Comparative Education, Teachers College, Columbia University.
- J.Ba.** JACQUES BARZUN, A.B., A.M., Ph.D.
Instructor in History, Columbia University.

- J.B.H.** J. BARTON HOAG, A.B., Ph.D.
Assistant Professor of Physics, University of Chicago; President of the Chicago Section, Institute of Radio Engineers.
- J.B.McN.** JAMES BIRTLEY McNAIR, A.B., A.M.
Assistant Curator of Economic Botany, Field Museum of Natural History.
- J.B.S.** JOSEPH BENJAMIN SHEPHERD, B.S.A.
Associate Dairy Husbandman, Bureau of Dairy Industry, United States Department of Agriculture.
- J.C.** JOE CRITES, E.M.
Chief Engineer, Raymond Brothers Impact Pulverizer Co.
- J.C.C.** JOSEPH CUMMINGS CHASE.
Professor and Head of the Art Department, Hunter College, Official Portrait Painter for the United States Government with the American Expeditionary Forces.
- J.C.G.** J. C. GEIGER, B.A., M.A., M.D.
Senior Surgeon, United States Public Health Service; Health Officer City and County of San Francisco, 1931; Professor of Epidemiology, Hooper Foundation, 1930.
- J.C.W.** J. CLYDE WHETZEL, B.S., S.M.
Manager of the Research Laboratory, American Sheet and Tin Plate Co.
- J.E.P.** JOSEPH E. POGUE, A.B., Ph.D.
Consulting Engineer, formerly Assistant Curator of the Division of Mineralogy and Petrology, Smithsonian Institution; Associate Geologist, United States Geological Survey.
- J.H.G.** JOHN HIRAM GEROULD, Litt.B., A.M., Ph.D.
Professor of Zoology, Dartmouth College; Author of various scientific papers on marine invertebrates, butterflies and other insects, and on the history of the cell theory.
- J.H.K.** JOHN HARRISON KOLB, Ph.D.
Chairman of the Department of Rural Sociology, College of Agriculture, University of Wisconsin.
- J.J.** JOSEPH JASTROW, A.B., A.M., Ph.D., LL.D.
Lecturer on Psychology, New School for Social Research; Professor Emeritus, University of Wisconsin.
- J.J.L.** JOHN JOSEPH LAUX, B.A., M.A.
Professor of Philosophy and Church History, Villa Madonna College; Priest of the Diocese of Covington, Ky.
- J.L.D.** JOHN LESENE DEWITT.
Major-General, United States Army; Quartermaster General, War Department.
- J.L.F.** JAMES LLOYD FRI, M.B.A.
Manager of the Merchandise Managers' Division, National Retail Dry Goods Association.
- J.P.D.** JOSEPH PAUL DAY.
Real Estate Broker.
- J.P.G.** JACOB P. GREENHILL, B.S., M.D., F.A.C.S.
Associate in Obstetrics, Northwestern Medical School and Attending Gynecologist, Cook County Hospital.
- J.R.N.** J. RALEIGH NELSON, A.M.
Professor of English in the College of Engineering and Architecture and Editor of the Department of Engineering Research, University of Michigan.
- J.R.T.** JAY R. TRAVER, B.A., M.A., Ph.D.
Instructor in Entomology, Cornell University.
- J.S.B.** JOHN SAEGER BRADWAY, A.B., A.M., LL.B.
Secretary of the National Association of Legal Aid Organizations, School of Law, Duke University.
- K.C.** KENNETH JOHN CONANT, A.B., M.Arch., Ph.D.
Associate Professor of Architecture, Harvard University.
- K.D.S.** KENNETH D. SULTZER, A.B.
Instructor in English and Supervisor of Admissions, Home Study Department, Columbia University.
- K.K.** KARL KAMMERMEYER, B.S. in Chem.E., M.S.
Research Associate, Department of Engineering Research, University of Michigan.
- K.T.** KURT TOENSFELDT, B.S., M.E.
Manager, Patent Department, International Combustion Engineering Corporation, New York.
- L.Br.** LAWRENCE BROWN, B.S.
Staff Member of the *New York Herald-Tribune*, 1926-28
- L.B.S.** LOUIS BEVIER SPINNEY, B.S., B.M.E.
Professor of Physics, Iowa State College.
- L.C.A.** LEIGH CHARLES ANDERSON, B.S. in Chem., M.S., Ph.D.
Assistant Professor of Organic Chemistry, University of Michigan.
- LeR.E.B.** LeROY EDWARD BOWMAN, A.B.
Secretary of the National Community Center Association.
- L.F.** LOUIS FLADER.
Commissioner, American Photo-Engravers' Association; Editor, *Photo-Engravers' Bulletin*.
- L.G.H.** LUTHER GRANT HECTOR, A.B., A.M., Ph.D.
Professor of Physics, University of Buffalo; Radio Editor, *The Buffalo Evening News*.
- L.H.D.** LYSER H. DEWEY, B.S.
Senior Botanist in charge of Fiber Plant Investigations, United States Department of Agriculture.
- L.H.G.** LOUIS HERBERT GRAY, A.B., A.M., Ph.D.
Professor of Oriental Languages, Columbia University; Member of the American Linguistic Society, Fellow of the American Academy of Arts and Sciences.
- L.H.Mo.** LACEY H. MORRISON, B.S. in M.E.
Associate Editor, *Power*; Author of *Oil Engines*, *American Diesel Engines*, *Refrigeration*, *Lubrication*, *Fuel Oil Burning*.
- L.K.F.** LEE KAUFER FRANKEL, B.S., Ph.D.
Second Vice-President, Metropolitan Life Insurance Co.
- L.O.K.** LOUIS OTTO KUNKEL, A.B., A.M., Ph.D.
Pathologist, Boyce Thompson Institute, Yonkers, N.Y.
- L.R.** LAWSON ROBERTSON.
Assistant Professor of Physical Education, University of Pennsylvania, Coach of the University of Pennsylvania Track Team and of the American Olympic Team, 1920-32.
- L.S.M.** LEWIS SEYMOUR MUDGE, M.A., D.D., LL.D.
Stated Clerk of the General Assembly of the Presbyterian Church in the United States; Member of the Federal Council of Churches of Christ in America; Moderator of the General Assembly, 1931.
- L.V.R.** LAWRENCE VINCENT REDMAN, D.Sc., LL.D.
Vice-President and Director of Research, the Bakelite Corporation; President of the American Chemical Society.
- M.B.H.** MARY BRONSON HARTT.
Scientific Writer and Editor.
- M.D.D.** MARGUERITE D. DARKOW, A.B., M.Sc., Ph.D.
Assistant Professor of Mathematics, Hunter College.
- M.F.** MORRIS FISHBEIN, B.Sc., M.D.
Editor, *The Journal of the American Medical Association*; Associate Clinical Professor of Medicine, University of Chicago; Chairman, Committee on Foods of the American Medical Association.
- M.Go.** MOSES GOMBERG, Sc.D.
Professor of Chemistry, University of Michigan; President of the American Chemical Society, 1931.
- M.G.K.** MAURICE GRENVILLE KAINS, B.S.A., M.S.A.
Horticulturalist; formerly Special Crop Culturist, United States Department of Agriculture; Professor of Horticulture and Department head, Pennsylvania State College, 1914-16.

- M.J.H.** MAXMILIAN JOHN HUBENY, M.D.
Roentgenologist, American College of Radiology, Radiological Society of North America
- M.N.** MARCUS NADLER, B.S., J.D.
Associate Professor of Finance, New York University, and Research Director, Institute of International Finance.
- M.R.** MABEL ROLLINS, A.B., M.S.
Associate in Journalism, Columbia University, Associate Editor of *McClure's*, Editor of *House Beautiful*.
- M.S.** MARGARET SAWYER, B.S.
Director of the Department of Consumer Service, General Foods Corporation; National Director, Nutrition Service, American National Red Cross.
- M.S.E.** MARY STOCKTON EDWARDS, B.A.
Acting Director, Division of Legal and Protective Measures, American Social Hygiene Association.
- M.T.B.** MABEL T. BOARDMAN, A.M., LL.D.
Secretary of the American Red Cross, Member of the Central Committee, and National Director of Volunteer Service.
- N.A.-C.** NATHAN ALTSHILLER-COURT, D.Sc.
Associate Professor of Mathematics, University of Oklahoma.
- N.E.P.** NORMA E. PFEIFFER, S.B., Ph.D.
Morphologist, Boyce Thompson Institute, Yonkers, N.Y.; formerly Associate Professor of Botany, University of North Dakota.
- N.R.B.** N. ROBERT BEAR, B.S. in Agr.
Research Assistant and Extension Specialist, Agricultural Engineering Department, Ohio State University.
- N.T.** NORMAN TAYLOR.
Formerly Curator, Brooklyn Botanic Garden, Assistant Curator, New York Botanical Garden, Editor, *Journal of the International Garden Club*; Associate Editor, *Ecology*.
- N.W.K.** NORMAN WILLIAM KRASE, B.S., M.S., Ph.D.
Associate Professor of Chemistry, University of Illinois.
- O.M.S.** OLIVER MARTIN SAYLER, A.B.
Author, Lecturer, Dramatic and Literary Critic.
- O.R.** OTTO REINMUTH, B.S., M.S., Ph.D.
Associate Editor, *Journal of Chemical Education*, Johns Hopkins University.
- O.T.** ORDWAY TEAD, A.B.
Editor of business books; Lecturer in Personnel Administration, Columbia University; Member of the Department of Industry, New York School of Social Work.
- P.E.S.** PAUL EARLS SABINE, Ph.D.
Research Physicist and Consultant, Architectural Acoustics, Riverbank Laboratories, Geneva, Ill.
- P.F.B.** PAUL FREDERICK BRISSENDEN, A.B., A.M., Ph.D.
Assistant Professor of Economics, School of Business, Columbia University.
- P.I.W.** PETER I. WOLD, B.S., E.E., Ph.D.
Professor of Physics and Head of the Department of Physics, Union College; formerly Professor of Physics, American Indemnity College, Peiping, China.
- P.M.A.** PERCY MAX APFELBAUM, B.S., M.A., Chem.E.
Instructor in Chemistry, College of the City of New York.
- P.N.L.** PAUL NICHOLAS LEECH, A.B., Sc.M., Ph.D.
Director of the Chemical Laboratory, American Medical Association; Fellow of the American Medical Association; Member of the American Chemical Society.
- P.V.S.** PAUL VANORDEN SHAW, B.A., M.A., Ph.D., B.Sc. ET LITT.
Instructor in Latin-American History, Columbia University; Lecturer and Writer on Latin America.
- P.W.** PERCIVAL WILDE, B.S.
Secretary, The American Dramatists; Visiting Lecturer, University of Miami; Author of *The Craftsmanship of the One-Act Play*, *The Unseen Host* and *Other War Plays*, *Eight Comedies for Little Theatres* and *The Devil's Booth*.
- P.W.S.** PHILIP WILLIAM SWAIN, A.B., Ph B., M.E.
Associate Editor, *Power*, formerly Instructor in Mechanical Engineering, Yale University.
- P.W.Z.** PERCY W. ZIMMERMAN, S.B., M.S., Ph.D.
Plant Physiologist, Boyce Thompson Institute, Yonkers, N.Y.; formerly Professor of Botany and Dean of the College of Agriculture, University of Maryland.
- R.E.C.** ROBERT EDWARD COONTZ, LL.D., DR. NAV. SC.
Admiral, United States Navy, Retired, Commander-in-Chief of the United States Fleet, 1923-25, Governor of Guam, 1912-13, Commandant of Midshipmen, United States Naval Academy, 1910-11.
- R.E.Ch.** ROBERT EMMET CHADDOCK, Ph D., LL.D.
Professor of Statistics, Social Science Division, Columbia University; American Delegate to the Assembly of the International Union for the Scientific Investigation of Population Problems, Paris, 1928, London, 1931.
- R.F.K.** ROBERT FULTON KELLY.
Polo and Intercollegiate Sports Editor, *New York Times*.
- R.H.Ba.** ROLAND H. BAINTON, B.A., B.D., Ph.D.
Assistant Professor of Church History, Yale University.
- R.J.M.** ROBERT JEROME MOORE, B.S., A.M.
Development Manager, Varnish Resin Division, Bachelte Corporation, Bloomfield, N.J.; Secretary, Paint and Varnish Division, American Chemical Society.
- R.L.Bu.** RAYMOND LESLIE BUELL, B.A., M.A., Ph.D.
Research Director, Foreign Policy Association, New York City; formerly Assistant Professor of Government, Harvard University.
- R.L.Ce.** RUSSELL LAFAYETTE CECIL, A.B., M.D., Sc.D.
Assistant Professor of Clinical Medicine, Cornell University Medical School, Assistant Visiting Physician, Bellevue Hospital, New York.
- R.M.U.** RUTH MURRAY UNDERHILL, B.A.
Assistant in Anthropology, Barnard College, Columbia University.
- R.N.B.** RUFUS NORMAN BOARDMAN, Ph.D.
Formerly Fellow of Philosophy in the University of Chicago, and Professor of Education in the Minot State Teachers College, North Dakota.
- R.N.Ba.** ROGER N. BALDWIN, A.B., A.M.
Director, American Civil Liberties Union; Co-author of *Juvenile Courts and Probation* and *Liberty under the Soviets*.
- R.O.** RUSSELL OWEN.
Staff Writer for the *New York Times*; Winner of the Pulitzer Prize of 1930 for the best example of a reporter's work during the year; Byrd and the Amundsen-Ellsworth-Noble Flights over the North Pole; Correspondent with the Byrd Expedition in the Antarctic, 1928-30.
- R.Pe.** RALPH PEMBERTON, B.S., M.S., M.D.
Professor of Medicine, Graduate School of Medicine, University of Pennsylvania; Member of the Council on Physical Therapy of the American Medical Association.
- R.S.W.** ROY SMITH WALLACE, A.B.
Welfare Worker; Member of the Playground and Recreation Association of America.
- R.S.Wa.** RUTH SAWTELL WALLIS, A.B., A.M., Ph.D.
Assistant Professor of Sociology, Hamline University; Staff Anthropologist in charge of Physical Growth Study, Bureau of Educational Experiments, New York City, 1926-30.
- R.T.C.** RICHARD THRELKELD COX, B.A., Ph.D.
Associate Professor of Physics, New York University.
- R.W.** ROBERT WITHINGTON, A.B., A.M., Ph.D.
Assistant and Associate Professor of English Language and Literature, Smith College.

- S.C.V.** SAMUEL CURTIS VESTAL.
Colonel, Coast Artillery Corps, United States Army
- S.C.W.** SCHUYLER C. WALLACE, A.B., A.M., Ph.D.
Assistant Professor in Public Law, Columbia University.
- S.D.** STUART DAGGETT, A.B., A.M., Ph.D.
Professor of Transportation, Department of Economics, University of California.
- S.E.J.** SMITH ELY JELLIFFE, A.B., A.M., M.D., Ph.D.
Neurologist; Managing Editor, *Journal of Nervous and Mental Disease*; Member of the American Neurological Association.
- S.F.K.** SHERWIN FINCH KELLY, B.Sc. in Min.E.
Geologist and Geophysicist; Partner, Low & Kelly.
- S.H.C.** SAMUEL H. CROSS, A.B., Ph.D.
Assistant Professor of Slavic Languages and Literatures, Harvard University, Chief of the European Division, United States Department of Commerce, 1925-26.
- S.J.** SANDERFORD JARMAN.
Senior Instructor, Coast Artillery Tactics; Special duty, Headquarters United States Military Academy.
- S.McK.** SAMUEL McKEE, JR., A.B., M.A.
Instructor in History, Columbia University.
- S.R.W.** SAMUEL ROBINSON WILLIAMS, Ph.B., M.A., Ph.D., D.Sc.
Professor of Physics, Amherst College
- T.C.J.** THATCHER C. JONES, Ph.D., M.C.S.
Assistant Professor of Finance, Department of Banking and Finance, New York University.
- T.D.P.** THOMAS DOANE PERRY, A.B., B.S.
Chief Engineer, United Plywood Corp., New Albany, Ind.
- T.F.H.** TALBOT FAULKNER HAMLIN, B.A., B.Arch.
Practicing Architect.
- T.H.D.** THOMAS H. DICKINSON, A.M., Ph.D.
Associate Professor of English, University of Wisconsin.
- T.R.S.** THEODORE R. SCHELLENBERG, A.M.
Instructor in History, University of Pennsylvania.
- T.S.** THEODORE SOLLER, B.A., M.A., Ph.D.
Instructor in Physics, Amherst College.
- T.St.** THEODORE STEARNS, M.Mus.
Formerly Music Critic, *The New York Morning Telegraph*.
- T.Wo.** THOMAS WOODY, A.B., A.M., Ph.D.
Professor of History and Geography, Swarthmore College.
- V.G.I.** V. GILMORE IDEN, B.A.
Director of Public Relations, American Institute of Steel Construction, New York City; formerly Managing Editor, *New York Journal of Commerce*.
- V.M.** VLADIMIR MINORSKY.
Professor at the National School of Oriental Languages, Paris; formerly Councilor of the Russian Legation, Teheran.
- W.A.** WALLACE ASHBY, B.S., A.E.
Senior Agricultural Engineer, Bureau of Agricultural Engineering, United States Department of Agriculture
- W.A.G.** WILLIAM ALEXANDER GIBBONS, M.A., Ph.D.
Director of the Development Department, United States Rubber Co., Passaic, N. J.
- W.B.K.** WILLIAM BECK KEMP, Ph.D.
Professor of Genetics and Statistics, and Assistant Dean of the College of Agriculture, University of Maryland
- W.C.L.** WALTER CONSUELO LANGSAM, A.M., Ph.D.
Instructor, Department of History, Columbia University.
- W.E.E.** W. ELMER EKBLAW, A.B., A.M., Ph.D.
Professor of Geography, Clark University, Editor, *Home Geography Monthly*, Botanist and Geologist, Crocker Arctic Expedition, Author of *Along Unknown Shores*.
- W.G.H.** W. GERALD HOLMES, A.B.
Industrial Engineer, New England Public Service Co.
- W.H.E.** WALTER HOLLIS EDDY, B.S., A.M., Ph.D.
Professor of Physiological Chemistry, Teachers College, Columbia University; Consulting Chemist.
- W.H.O.** WILLIAM HENRY OWEN, B.A., M.A., B.D.
Rector, Holy Trinity Church, New York City; Trustee of the Cathedral of St. John the Divine, President of the Board of Examining Chaplains, Diocese of New York.
- W.H.T.** WILLIAM H. TIMBIE, A.B.
Professor of Electrical Engineering and Industrial Practice, Massachusetts Institute of Technology, Editor-in-Chief, War Department Committee on Education and Special Training.
- W.I.B.** WALTER I. BRANDT, M.A., Ph.D.
Associate Professor of History, College of the City of New York.
- W.I.F.** WILLIAM I. FISHBEIN, B.S., M.D.
Assistant Health Editor, *The Chicago Daily News*; School Physician, The Laboratory Schools, University of Chicago.
- W.J.D.** WALTER JULES DOUGLAS, C.E.
Consulting Engineer, Department of Bridges, Tunnels, Buildings and Harbors, Parsons, Klapp, Brinckerhoff & Douglas, New York City.
- W.J.L.** WILLEM JACOB LUYTEN, Ph.D.
Professor of Astronomy and Head of the Department, University of Minnesota; Author of *The Pageant of the Stars*.
- W.J.S.K.** WENDELL J. S. KREIG, B.S., M.S.
Instructor in Anatomy, Division of Anatomy, New York University.
- W.K.F.** WALLACE K. FERGUSON, B.A., M.A., Ph.D.
Assistant Professor of History, New York University.
- W.M.H.** WILBUR MAGRUDER HURST, B.S.
Associate Agricultural Engineer, United States Bureau of Agricultural Engineering.
- W.P.** WINTHROP PARKHURST.
Music Writer and Critic; formerly Critic, *Musical America*.
- W.S.R.** WILLIAM SEARS RAINEY, A.B.
Production Manager, National Radio Broadcasting Co.
- W.T.B.** WALTER THEODORE BROWN, M.A., Ph.D.
Professor of Religion, Yale University.
- W.W.C.** WINN W. CHASE.
Assistant Editor, *The Textile World*; formerly Member of the Chemical Warfare Service.
- W.W.H.** WESLEY WINANS HORNER, B.S. in C.E., C.E.
Chief Engineer, Sewers and Paving, City of St. Louis, Mo.; Member and Past President of the American Society of Municipal Engineers Executive Committee.
- W.W.S.** WILLIAM WARREN STIFLER, A.M., Ph.D.
Professor of Physics, Amherst College; formerly Head of the Department of Physics and Dean of Premedical School, Peking Union Medical College, China.
- W.Z.** WILLIAM ZORACH.
Sculptor, known especially for his heads and torsos in marble and granite, and for his figures and bas-reliefs carved in wood.

METHOD OF CROSS REFERENCES

Words in the articles printed in large and small capitals indicate that there is an article on that subject elsewhere in The National Encyclopedia

The National Encyclopedia

PERSIA

P

RYSWICK

PERSIA, a kingdom of western Asia, lying south of the Caspian Sea and Russia, east of Afghanistan and the British India area of Baluchistan, west of Turkey and the kingdom of Iraq and north of the Persian Gulf and the Gulf of Oman. Persia has an area of 628,000 sq. mi.

Surface Features. Most of Persia lies in the great Iranian Plateau. Mountain ranges run roughly from the northwest across the country for 800 mi. to the southeast, and in the south and northeast. The plateau itself averages approximately 5,000 ft. above sea level; the mountain ranges contain peaks rising 11,000 and 12,000 ft. and over. The plateau region is in the nature of a great basin, sloping downward toward the center, with fairly narrow outer areas sloping to the Caspian Sea and Persian Gulf. Drainage from approximately 235,000 sq. mi. is into the Caspian Sea and Persian Gulf; that from the remaining 393,000 sq. mi. is to depressions in the interior of Persia. The four principal rivers, the Safid Rud, the Herhaz, the Gurgan and the Atrek, all drain into the Caspian Sea. A number of smaller rivers drain into the interior depressions. Across the center of Persia runs an hour-glass shaped desert region, 800 mi. long and varying from 100 to 250 mi. in width.

Climate. The rainfall is small over most of Persia, and generally is both spasmodic and variable. The temperature covers exceptionally wide ranges, both between winter and summer and between day and night. Northerly and northeasterly winds prevail throughout the year over most of the country, those in the summer being especially strong and frequently heavily dust-laden.

Flora and Fauna. Throughout most of Persia, the vegetation is scanty, though in a few regions, particularly in the north and in some sections of the hills, forests are found. Date palms thrive in many parts; olives are cultivated in some sections; grapes, apples, plums, cherries and most of the other European fruits are grown, some of them being exceptionally good. Rice and wheat are the principal grains; beans and various root vegetables are widely grown.

Persian wild animals include several species of the deer, cat and sheep families, and a wide variety of birds. The lion, formerly well-known, has practically disappeared; the tiger is found occasionally though less frequently than formerly. The bullock and donkey are used widely on the farms; the camel is an

important means of transport; the horse is much used. Sturgeon and herring are taken in considerable quantities from the Caspian Sea.

Population and Cities. The population of Persia is variously estimated at between 10,000,000 and 12,000,000. The capital of Persia is Teheran, located in the central north, with a population of approximately 250,000. Other important cities are: Tabriz, near the northwestern corner, 200,000; Isfahan, in central Persia, 100,000; Meshad, in the northeast, 80,000; Kerman, in the southeast, 50,000. There are 42 cities with a population of 10,000 or over. A large proportion of the population consists of nomadic Turks, Kurds, Arabs and Lurs, the total nomad population being approximately 3,000,000.

Religion. Mohammedanism came into Persia with the conquest of the country by the Arabs in the 7th century A.D. To-day seven-tenths of the people are Moslems of the Shiah, or "dissenters," sect. The religious differences with the caliphate of "orthodox" Mohammedanism were among the important causes of the long series of conflicts between Persian and Turkish rulers. The Mohammedan leaders, the highest of which are the *mujtahids*, play an exceedingly important part in the country, and have figured prominently in the establishment of constitutional government in recent decades. Most of the mosques own property or other endowments which pay for their upkeep and support the priests.

Zoroastrianism, the ancient religion of Persia, still has some 10,000 followers in the country, though the center of the faith was moved to India as a result of Mohammedan persecutions. Nestorian Christians number about 60,000, and there are approximately the same number of Armenian Christians. The Jews in Persia total roughly 40,000. Bahaism, started in Persia in 1844, has a considerable following. There are between four and five thousand Roman Catholics, and a small number of Protestant Christians.

Education. Formerly education consisted almost entirely of instruction in the Koran. Only a small number ever learned to read and write. During the 19th century, it became the custom for the sons of the wealthy or of the high officials to go to Europe for part of their education, with the result that a large proportion of the officials know English or French as well as Persian. In recent years the government has given much attention to the development of schools,

from the primary grade through universities. The foreign missionaries also have promoted education. The government now spends approximately \$2,000,000 yearly on education, as compared with \$700,000 in 1922. In 1928 there were 575 government schools for boys and girls, and 382 private schools. The government schools enrolled about 50,000 pupils, and the private schools 42,000. Some 250 schools are maintained by various foreign missionary organizations. The government, besides maintaining its own schools, provides subsidies for private schools, Persian and foreign, and supports a number of students in Europe. Several higher schools are maintained by the government, including medical, agricultural and other technical schools, as well as by missionary bodies. The principal higher school is the Central University at Teheran. The Anglo-Persian Oil Company maintains a number of schools for its employees and others.

Agriculture and Minerals. Rice, wheat, barley and cotton are the principal agricultural crops. Opium also is produced in considerable quantities, the Persian opium having an exceptionally high morphine content. The numerous small rivers and streams in the plateau region are used for irrigation; where such supplies of water are not available, dry farming methods are employed. The yield generally is comparatively poor, and in years when the rainfall is exceptionally small or absent semi-famine conditions quickly develop. In recent years under government and foreign auspices modern agricultural machinery, such as deep plows and tractors, has been introduced in some regions, with a notable increase in the yield. Comparatively little fertilizing is done. Rice is grown chiefly in the Caspian region; opium, raised chiefly for export to the Far East, is grown in many parts; cotton is produced in most of the provinces for local consumption, the exports going chiefly from the Caspian seaboard and the north. Fruits, grapes, tobacco and vegetables and melons of various kinds are grown, chiefly for local consumption though there are substantial exports of dried fruits and tobacco. Wool is produced in large amounts from the herds of the nomads, but most of the production is used in rug, carpet and cloth manufacturing in Persia. Production figures are approximately: wheat, 1,000,000 tons; barley, 570,000 tons; cotton, 30,000 tons; crude opium, 850,000 tons.

Persia possesses very large petroleum resources, and considerable deposits of iron, coal, borax, cobalt, copper, manganese and lead. Turquoise mines are worked crudely. Only the oil deposits are being worked in an important way. The concession for this development in all of Persia except part of the north is held by the Anglo-Persian Oil Company. Production in 1930 was 45,420,000 bbls.

Industry and Trade. Carpet and rug making by hand is by far the most important manufacturing industry in Persia. Cotton spinning, match making and the weaving of woolen cloth, after a series of vicissitudes, are beginning to get on a solid basis. The government, by requiring all officials and students

to wear Persian-made cloth, and in other ways has sought to encourage textile manufacturing.

Persia's imports consist chiefly of cotton piece goods and other manufactured articles, though sugar, tea and machinery are important items. The most important export item is oil, with woolen carpets and rugs second. Other exports are almost entirely agricultural products and wool. Imports grew from \$68,132,000 in 1924 to \$77,176,000 in 1930, and exports in the same period from \$76,839,000 to \$132,129,000. Persia regularly has an export excess, if the exports of oil be included, but an import excess if merchandise alone be counted. The export excess for the years 1924 to 1930 inclusive totalled \$238,345,000 to 30% of the total exports.

Persia's foreign trade is chiefly with Great Britain, British India and Russia. In the last pre-war year of 1913-14, Russia did 60% of Persia's foreign trade, Britain 12% and India 9%, making a total of 81%. The 1926-27 percentages were: Russia, 18; Great Britain, 32; India, 18; total 68%.

Communications. Persia is poorly supplied with railways, though plans for an elaborate system have been under discussion for years. The chief hindrance to construction has been rivalry between the Russian and British interests for construction rights, and the desire of the Persian government to keep control in its own hands. In 1930, Persia had approximately 300 mi. of railways, besides 35 mi. of light railway belonging to the Anglo-Persian Oil Company. A system of 900 mi. is planned, which will connect the Persian Gulf with the north and the Caspian Sea. Roads suitable for light automobile traffic total approximately 5,700 mi., of which 2,400 mi. are metalled. The number of motor cars and trucks in use has increased very rapidly in recent years. Telegraph connections have been established between the principal cities, and the country is crossed by two trunk lines connecting Europe with India.

Finances. Perhaps the principal cause of the demand for constitutional government at the beginning of the 20th century was the gross extravagance and corruption of the shah's court and of the provincial officials, which completely bankrupted the country in spite of heavy taxation. Financial difficulties also have been the cause of much international friction and the excuse for considerable foreign penetration into Persian administration. In 1911, in the effort to get the financial situation straightened out, the Persian government employed W. Morgan Shuster, an American, to serve as treasurer-general, in complete charge of all collection and expenditure of revenues. Russian opposition forced him out in eight months, but the value of having some arrangement of this sort was so well demonstrated that for most of the time since then Persian finances have been under the control of foreigners employed by the Persian government and of nationalities other than British or Russian.

Budgets for the six years beginning Mar. 21, 1925, showed an excess of receipts over expenditures of ap-

proximately \$10,700,000, with receipts averaging about \$30,150,000 and expenditures \$28,365,000. In 1919, by an agreement with Soviet Russia, all the pre-war Persian debts to Russia were cancelled. These amounted to approximately \$16,250,000. The national debt, funded and floating, on Mar. 20, 1928, the end of the fiscal year, totalled approximately \$8,900,000, with various comparatively small amounts in dispute. The treasury reserves on the same date totalled \$37,376,000. The government thus had cash in hand more than ample to pay all the national debt.

The land tax is the principal source of direct tax income. This and other direct and indirect taxes make up approximately 35% of the revenues. The customs receipts furnish roughly 25%, and the royalties from the Anglo-Persian Oil Company 20%. The army and police take approximately 40% of the expenditures and the civil list another 33%.

In 1899 a concession was given to British interests to establish the Imperial Bank of Persia, which was to serve as the government's fiscal agency. In 1927 the parliament authorized a new national bank, but the Imperial Bank remains the principal bank in the country. In 1931, the Imperial Bank, for a payment of \$1,000,000 gave up its exclusive right to issue notes, and its notes were retired in September of that year. Russian and Turkish banks have branches there.

The *qian* formerly was the standard currency unit. This was a silver unit, the exchange value of which fluctuated with the price of silver. Its "normal" exchange value was approximately ten cents. In 1929 the Persian parliament enacted that, effective from Mar. 21, 1930, a gold standard should be adopted, the unit being a *royal* with a gold content making it equivalent to one shilling or 24.3 cents. The *royal* is divided into 100 *dinars*. Coins include one in gold, the *pahlavi*, worth twenty *royals* and hence one pound sterling or \$4.85. Silver and copper coinage also is provided. The new currency began to go into actual circulation at the beginning of 1932.

Government. Until 1906, Persia was an absolute monarchy, more or less typically Oriental in character. The Mohammedan religious law, however, had great influence, as did the Mohammedan religious leaders. The degeneracy of the shahs led to a strong popular demand for constitutional government and on Dec. 30, 1906, a national assembly, called the Majlis, was set up. The efforts of the ruling house to regain absolute power and of the British and Russians to secure a dominant place in Persian affairs kept political conditions disturbed, but the Majlis continued to exercise great influence. In 1925 the Majlis deposed the shah, formally ended the rule of the Qajar dynasty and chose Reza Khan Pahlavi as shah. He was crowned Apr. 25, 1926. Under the present constitution, the form of government follows the general lines of a constitutional monarchy, with the premier appointed by the shah but responsible to the Majlis.

The country is divided into 26 provinces, with governors-general directly responsible to the central government. Local affairs are handled through what

amount to village units. The cities are governed by commissions. The "capitulations" system of consular jurisdiction was in force for most foreigners in Persia down until May 28, 1928, when, by unilateral declaration, but without foreign opposition, the capitulations were abolished, though special rules were made providing a measure of safeguard for foreigners. G. C.

PERSIA, HISTORY OF. Before 1500 B.C. a number of nomad Aryan tribes, belonging to the great Indo-European language family, wandered westward and southwestward from their homes east of the Caspian, and settled in a land called Iran, after their own name. The two most powerful of these tribes were the Persians, who made their home in the southern part of the Iranian plateau, and the Medes, who occupied the northwestern end.

Period of Conquest. For 200 years, beginning with the 9th century B.C., the Medes were molested by frequent depredations of Assyrian armies. But toward the end of the 7th century B.C., they themselves, under King Cyaxares, invaded Assyria and razed its capital Nineveh to the ground in 606 B.C. Soon afterward the Medes were in possession of an extensive empire which was not destined to last very long. In 550 B.C., Cyrus, King of Persia, overthrew his Median overlord, Astyages, and made himself master of the consolidated Medes and Persians. Then followed an extraordinary campaign of conquest during which the Lydian Empire and Babylonia fell before him, in 546 and 538 B.C., respectively. By the end of his reign, 529 B.C., Cyrus was ruler of all Western Asia.

The most notable achievement of his son and successor, Cambyses, 529-522 B.C., was the annexation of Egypt. He died while returning from a campaign, and for a short time the Persian throne was occupied by a usurper, Gaumata. The latter was slain by a military commander, Darius, who made himself king, claiming descent from the same line, the Achemenian, as Cyrus and his son. During his reign of 36 years, 521-485 B.C., Darius devoted himself to consolidating and extending his empire, which had grown to be the greatest the world had known. He divided his realm into 20 provinces, each governed by a satrap directly responsible to the Great King. The Persians proved themselves extremely tolerant toward vanquished peoples, whose artistic and intellectual ideals they frequently adopted. They were followers of the Zoroastrian religion, worshipping Ahuramazda, the principle of good, and venerating fire as a symbol of purity.

Conquered by Greece. To punish Athens for fostering rebellions in Asia Minor, Darius sent an expedition into Greece, which culminated in their crushing defeat at Marathon in 490 B.C., where the Greek phalanx of spearmen proved superior to the vaunted Persian archers. The war against Greece was continued by Xerxes I, 485-465 B.C., whose carefully planned campaigns met with overwhelming disasters: on sea at Salamis in 480 B.C., and on land at Plataea in 479 B.C. Xerxes then retired to the comparative security of his harem, living in licentious luxury while his empire was falling to pieces. The process of dis-

integration continued under his successors until a vigorous ruler, Artaxerxes III, 359-338 B.C., gathered together the remnants of the empire into a strong unit. But the restored power of Persia was short-lived; only eight years after Artaxerxes's death, his successor, Darius III, 336-330 B.C., fled ignominiously before the conquering Greeks under Alexander the Great. The latter assumed the title of King of Kings and added the Persian Empire to his own domain.

Following Alexander's death, 323 B.C., a long and bitter struggle ensued among his generals for mastery, during which most of the former Persian provinces fell to the lot of Seleucus Nicator, founder of the Seleucid dynasty, who reigned 312-280 B.C. Seleucus carried out the project of Alexander in Hellenizing his Greco-Persian empire, which he divided into 72 provinces. In almost every province he founded Greek or Macedonian colonies which developed into great centers of culture.

Rise and Fall of Parthian Empire. The successors of Seleucus found it extremely difficult to maintain their possessions. Under the stress of vitiating wars with Rome and continual provincial revolts, their hold weakened gradually. About 250 B.C., Bactria threw off the Seleucid suzerainty. The Parthians, led by a certain Arsaces, followed their example and established an independent kingdom. The 3rd century B.C. witnessed the rise of a great Arsacid king, Mithridates I, about 290-238 B.C., who overran Persia, Media and Babylonia. Through his conquests, the Parthian Empire, which endured for nearly four centuries, was raised to the rank of a world state. Its administration was fashioned after that of early Persia. Subject peoples were permitted a large degree of self-government, being asked only to pay tribute regularly and to furnish recruits for the imperial army. Rapid expansion brought the Parthian Empire into conflict with the rising power in the West, Rome, resulting in a series of life-and-death struggles between the two. Exhausted by these wars and by internal strife, Parthia lost province after province without being able to check their defections.

Sassanian Dynasty. It was natural that Persia, too, should seek her freedom. Finally, about 220 A.D., finding a capable leader in one Ardashir (Artaxerxes), the Persians rose in rebellion against their overlord, Artabanus. In three great battles, the last of which was fought in 226, they utterly routed their erstwhile masters. Thus the Persians once more won dominion over the East; for 426 years after, 226-652, they were ruled by the Sassanian dynasty founded by Ardashir.

Under the Sassanians, the ancient glory and splendor of Persia were restored. Its culture was freed from the Hellenistic domination of centuries, and a wonderful artistic renaissance was experienced, truly Oriental in spirit. Sassanian art, particularly in metal work and carpet weaving, was to have considerable influence on later Eastern and Western art. Throughout their reign, the Sassanian kings, like their Parthian predecessors, were plunged in continual warfare with Rome. Periods of peace between the two rivals were

never of long duration. The chief bone of contention was Armenia, which changed hands scores of times.

Among the great Sassanians was Shapur, whose remarkable reign of 70 years, 309-379, was largely occupied in establishing Zoroastrian orthodoxy in his empire, suppressing the Manichean heresy and Christianity, and waging fierce wars against the Roman emperors, Constantius and Julian Chosroes I (531-579). In spite of a costly war against Justinian, he raised Persia to its pinnacle of glory. Little more than a half century after his death, the Arabs carrying the banner of the new religion, Islam, began their conquest of Persia which ended in the defeat and assassination, 652, of Yexdigird III, last of the Sassanian dynasty, and opened up a new epoch for Persia under Mohammedan rule. A. DE.

BIBLIOGRAPHY—*Cambridge Ancient History*, vol. 4, 1926; C. I. Huart, *Ancient Persia and Iranian Civilization*, 1927; R. W. Rogers, *History of Ancient Persia*, 1929; Sir P. M. Sykes, *History of Persia*, 2 vols., 1930.

MODERN PERSIA

For five centuries after the death of Yexdigird Persia was under the nominal authority of the Mohammedan caliph. The period, however, was marked by a series of revolts by Persians, sometimes under their own leaders, sometimes under Muslim chiefs who sought to gain power. Several dynasties were established, some of them nominally acknowledging the authority of the caliphate. At the beginning of the 11th century, invaders from Turkestan seized control of the country. Persia became part of the empire of Genghis Khan in the later years of the 12th century, and in 1256 the son of one of the Mongol governors assumed the throne and made Persia again an independent national unit, though nominal allegiance was given for a time to the Great Khan in China. For another century, the history of Persia is marked by a series of wars with neighboring countries, particularly with the lands to the west, and between rivals for power in Persia. Timur, otherwise called Tamerlane, secured control in 1395, and his descendants ruled for a short time following his death in 1405.

In 1499 Ismail, whom the Persians believed to be a descendant of the last of the Sassanid rulers and revered as such, secured the throne and established the Safavi dynasty which ruled until 1736. During this interval, a series of conflicts occurred with Turkey, with attacks coming successively from one side or the other. These conflicts were due in large part to religious differences, the Persians having adhered to the *shiah*, or dissenters sect.

Shah Abbas I, ruling from 1587-1629, proved himself a notable warrior and administrator. During his reign, western Europeans began to find their way to Persia. Abbas utilized the services of two English knights to reconstruct and rearm his army, and welcomed the coming of British traders and their naval supports as a means of offsetting the dominance which the Portuguese had acquired in the Persian Gulf. The dynasty degenerated after Abbas's death, and

in 1722-24 Persia was the victim of a series of attacks by Afghan leaders and by Russia and Turkey. The latter year saw an agreement for the division of Persian territory between Russia, then ruled by Peter the Great, and Turkey. The Afghans were ousted in 1730 by troops under the command of Nadir Kuli. Two years later Nadir had ousted the Turks from the area they had seized. Russia evacuated the Caspian provinces in 1732, following the death of Peter the Great, and when war broke out between Turkey and Russia in 1735 Nadir secured the rest of the Persian territory which Russia had taken. In 1736 he was elected Shah, and ruled until 1747. Two years after his election he made a raid into India, and succeeded in reaching and sacking Delhi. His assassination in 1747 was followed by half a century of confusion. Then came the establishment of the Qajar dynasty in 1794, which lasted until 1925.

Victim of Russian and British Interests. Persia definitely became a factor in European affairs during this dynasty, chiefly as a victim, actual or potential, of the desire of European Powers for expansion. Since Persia lay between India and Russia, British and Russian interests were especially active in the country. The Qajar rulers, in the latter part of the 19th century, proved themselves notably weak and extravagant and contributed much to Persia's international difficulties. Napoleon worked out a plan for the invasion of India by Persian, Russian and French troops acting together, and for a time French influence was strong. In 1814, however, the British secured a treaty in which, in return for a subsidy of £150,000 a year, Persia agreed not to engage in any aggressive war. Two unsuccessful attacks on Russia, in an effort to recover control of Georgia, led to the cancellation of the subsidy and to the Treaty of Turkomanchai, signed in 1828, which formed the basis of foreign relations with Persia for many years. This treaty established extraterritoriality for foreigners, and fixed a five per cent tax on imports and exports. Trouble arose with Britain over Afghanistan, which was ended in 1857 when the Shah agreed to recognize the independence of that country. The British were particularly concerned because Russian influence had been growing in Persia, and control of Afghanistan by Persia would have opened the way for Russia through Afghanistan to India. The latter half of the 19th century was marked, for Persia, by the steady expansion of Russian influence to the north and of British to the east and south.

Shah Muzaffar-ud-Din, who ascended the throne in 1896, borrowed large sums from Russia and wasted the money in reckless extravagance. During his reign the Administration went rapidly to pieces and brigandage became rife throughout the country. Soon after he became Shah, the movement for Constitutional Government started. This took on definite form in 1905 when a large number of the inhabitants of the capital, Teheran, took sanctuary, or *bast*, in the mosques, demanding the dismissal of the vizier and the creation of a "house of justice." The Shah fin-

ally dismissed the vizier, but did nothing more, and repressive measures led to a second and larger-scale *bast* in 1906, and to threats by the religious leaders to put the country under an interdict. This time a Constitution and a national assembly were demanded. The Shah finally yielded, and the assembly, called the Majlis, met in Oct. 1906. The Shah died soon after. His son, who succeeded to the throne, already had acquired a most unsavory reputation, and his actions as Shah confirmed the reputation. He made several promises to obey the Constitution, but took every opportunity to repudiate the authority of the Majlis. Financial conditions went from bad to worse, the Shah and the Majlis came into open armed conflict, and bombardment of the Majlis by the Shah led to a revolt starting at Tabriz. In 1909 the Shah finally was forced to abdicate and leave the country.

Meanwhile, in 1907, Russia and Britain had signed an agreement, without securing Persia's consent or even consulting her, which divided the country into three spheres. Russia was to dominate in a large area in the north; Britain was to control a smaller section in the south; between was to be a neutral zone. This agreement roused popular feeling to a high pitch. Russia assisted in the development of a "Cossack brigade" nominally under the Shah, in Teheran, which played an important part in the Shah's conflict with the Majlis. Russia also interfered in the revolt of 1907-09, and when the World War broke out had many troops in northern Persia. The 1907 agreement pledged both Britain and Russia to complete abstention from interference with the integrity of Persia; but the British Government failed to make vigorous protests against the Russian penetration into northern Persia. This 1907 agreement has been cancelled as a result of developments since the World War.

War and Post-War Periods. During the war period, Persia, though remaining neutral, was the scene of considerable fighting between the Allies and their enemies, the British, Russians, Germans and Turks all being involved. There was much destruction of life and property. In 1919 a treaty was concluded with Britain which renewed the pledges of respect for Persian independence but provided for British expert advisers in the Persian administration and substantial British loans. This in effect gave Britain control of Persia; but the treaty lapsed with the fall of the Persian Cabinet which had negotiated it. In the same year an agreement was made with Russia which canceled all the former Russian concessions in north Persia, canceled the Persian debts to Tzarist Russia, canceled extraterritoriality for Soviet citizens and reopened the Caspian Sea to joint navigation. Persia became one of the initial members of the League of Nations and, in 1928, was elected to a non-permanent seat on the Council of the League.

In an attempt to get the Government finances on a solid basis, the Persian Government, in 1911, employed W. Morgan Shuster, an American, as treasurer general, with full control of all Government re-

ceipts and expenditures. He soon came into conflict with Russian interests seeking to dominate Persia, and was dismissed, at Russia's demand, after eight months of service. Belgian members of the Customs Administration attempted to carry on the financial reconstruction as employees of the Persian Government. In 1922 A. C. Millspaugh, an American, became administrator general of finances, and held the post until 1927 when he refused a new contract which provided for a reduction of his authority. His departure was followed by the adoption of a bill by the Majlis providing for four foreign financial experts who would head departments of the financial administration but be under the Persian minister of finance. Two were to be Germans and two Swiss. Another change, however, brought in a Belgian, Deckerckheer, as treasurer general. During the period of these various changes, the finances of the country had been put into such good shape that the public debt had been reduced and a surplus built up considerably in excess of the amount needed to pay the balance of the debt. Revenues had been increased and expenses reduced so that the income regularly exceeds the expenditures.

Fall of Qajar Dynasty. A coup d'état in Teheran in 1919 led to the establishment of a virtual dictatorship under Reza Khan Pahlavi in 1921. The Shah fled to Europe in 1923. On Oct. 31, 1925, the Majlis formally deposed the Shah, and Reza Khan was elected Shah, with right of succession to his heirs. He took the oath to defend the constitution on Dec. 15; was proclaimed on Dec. 16, and crowned on Apr. 25, 1926.

In 1927 the new Shah gave notice that the extraterritorial rights of foreigners would end the next year. This came into effect on the day set, May 28, 1928. A few days earlier Britain signed a new treaty granting Persian tariff autonomy and providing moderate safeguards for Britons after the abolition of the "capitulations."

On Oct. 1, 1927, a new agreement was signed with Russia pledging mutual non-aggression and non-interference and restoring fishing in the Caspian as a joint enterprise. This ended a series of disputes which had arisen between Persia and Russia. A protracted dispute with the kingdom of Iraq was ended by a provisional agreement signed Aug. 11, 1929. The Persians had objected to certain Iraqi rules as to nationality, and had demanded the same extraterritoriality rights for their many subjects in Iraq as were granted to the European Powers. Difficulties which had arisen with Turkey as a result of raids by Kurdish tribesmen, occupying border territories, developed in 1925 and were renewed by new Kurdish revolts in 1930. There was, however, no threat of war between Persia and Turkey. Sporadic revolts broke out in various parts of Persia in 1928, 1929 and 1930, but were put down with comparatively little difficulty. A dispute arose in 1928 between Britain and Persia over control of the Bahrein islands in the Persian Gulf, Persia claiming suzerainty.

Recent years, especially those in which Reza Khan has been Shah, have seen striking developments in virtually every phase of life in Persia. The financial chaos has been cleared up. Education has been developed notably. Women have claimed and been given enormously increased freedom. Air communications with Europe have been established by arrangements with British and German interests. Many hundreds of miles of motor roads have been built. A start has been made on industrial development. The army has been reorganized and made efficient. As a result of these and similar changes, Persia has secured in fact as well as in theory control of her own affairs.

G. C.

BIBLIOGRAPHY.—S. G. W. Benjamin, *Persia and the Persians*, 1891; E. G. Brown, *The Persian Revolution*, 1910; W. Morgan Shuster, *The Strangling of Persia*, 1912; A. C. Millspaugh, *The Financial and Economic Situation of Persia*, 1926, *Cambridge Ancient History*, Vol. 4, 1926; V. Shean, *The New Persia*, 1927; C. I. Hunt, *Ancient Persian and Human Civilization*, 1927; R. W. Rogers, *History of Ancient Persia*, 1929; Sir P. M. Sykes, *History of Persia*, 2 vols., 1930.

PERSIAN ART. The art of the Persians falls into two main divisions: that of pre-Mohammedan times, and that following the introduction of Mohammedanism in the 7th century A.D.

No art of importance was developed in Persia until the time of the Achaemenian Dynasty (559-330 B.C.). The art of this period was eclectic, derived from motives of various nations conquered by the Persians. It reveals for the most part a combination of Egyptian, Assyrio-Babylonian and Hellenic influences.

The most important remains of Achaemenian architecture are the ruins of royal residences at PERSEPOLIS and at Susa. Eclecticism is the dominant feature of these monuments, which are built of stone, brick and wood. At Persepolis the buildings rest upon raised platforms like those of Babylonia and Assyria. Guarding the portals are colossal human-headed, winged bulls, a feature derived from the same sources. Colonnaded halls, such as the famous Hypostyle Hall of Xerxes, closely resemble those of Egypt. The Persian columns, with their high bases and slender, deeply fluted shafts, point to Ionic-Greek influences. The capitals of these columns form the most original feature of Persian architecture. They consist of the foreparts of the bodies of two bulls placed back to back, resting on scrolls placed vertically, a strange design showing more elaboration than taste.

Persian buildings are rich in relief sculpture, consisting mainly of bas-reliefs of glazed tile. Processions and triumphs of kings form the chief subjects of these wall decorations. A celebrated frieze taken from the palace of Darius at Susa, and now at the Louvre in Paris, represents Persian archers in rhythmic array. In another noteworthy frieze of this same period, Darius is shown standing above a fallen enemy, pointing with scorn to ten prisoners bound together with ropes around their necks.

Remains of sepulchral architecture consist chiefly of the tombs of kings at Pasargada. Most interest-

ing of these is the tomb of Cyrus, built of blocks of highly polished white marble, rising on seven terrace-like steps to a gabled roof. In form and in the handling of materials it shows definite Ionic traces. Other tombs, notably that of Darius at Persepolis, are hewn from the living rock, resembling the rock-cut tombs of Egypt. The ancient Persians had no temples, but in accordance with the religion of Zarathustra, they built sanctuaries in which burned the sacred flame, symbol of Ahura Mazda. Remains of fire sanctuaries are found at Naksh-i-Rustam and at Firouz Abad.

The Persians of the Achaemenian period were skilled craftsmen, excelling in metal-work and the glyptic art.

Persian art fell into a decline during the Seleucid and Parthian dynasties which followed the Achaemenian. Under the powerful Sassanian Empire (226-641 A.D.), an artistic renaissance was experienced, all the arts of the Achaemenian period being carried forward to a higher degree of development, especially silk-weaving and enamel- and metal-work. An exquisite sense for color and design that characterized Sassanian art was to have a profound and far-reaching influence on the Persian, Mohammedan and Byzantine arts of later times.

With the Mohammedanizing of Persia in the 7th century, a new era is marked. The Persian architecture of this period is described in the article on MOHAMMEDAN ART. Sculpture, as in other Mohammedan countries, became practically a lost art, owing to the strict proscriptions against images contained in the sacred writings of Islam. Not so with painting, however. Manuscript illumination and other branches of miniature painting reached, in the course of centuries, an unsurpassed degree of excellence. When the Mongols invaded Persia in the 13th century, they found miniature painting occupying an important place in the art of that country. The influences of the Far East introduced by the Mongols and assimilated by the Persians gave to their art a new virility and broadened vision. Perhaps the finest example of book illumination of the Mongol period is the Jami-al-Tawarikh manuscript of the early 14th century. Under the Timurid and Safavid rulers, who proved to be lavish patrons of the arts, celebrated schools of book-making flourished at Semarkand, Herat and Bokhara. These books are as beautifully written as they are illustrated, for calligraphy was considered a fine art by the Persians.

The greatest master of Persian painting was Bihzad of Herat (c. 1450-1520). The delicacy of his lines, the microscopic exactness of details and the remarkable realism in his miniature portraits and landscapes, earn him a place among the great painters of the world.

In the 18th century, miniature painting in Persia underwent a decline which has continued to the present time. It still remains, however, one of the important arts.

The glazed pottery of medieval Persia, particularly that produced at Rakka, Rhages and Sultanabad, is

justly celebrated throughout the world. It is characterized by beautiful blue coloration and careful designs. These features are true of another branch of ceramics, that of glazed tiles, which were extensively employed in the decoration of buildings.

Rug-weaving has always been an important branch of Persian art. Persian rugs of the 15th, 16th and 17th centuries are perhaps the finest ever woven. In their making soft rich colors were remarkably blended to form elaborate geometric and naturalistic designs. The Persians were also skilled in metal-work, as can be seen in their metal inlaying and in the decoration of their armor.

BIBLIOGRAPHY—F. P. T. Sarre, *L'art de la Perse ancienne*, 1921; C. I. Huart, *Ancient Persia and Iranian Civilization*, 1927; P. M. Sykes, *History of Persia*, 2 vols., 1930.

PERSIAN GULF, a part of the Indian Ocean extending between Persia and Arabia, about 500 mi. long and 200 mi. wide. Its area is about 100,000 sq. mi. and its greatest depth 45 fathoms. The Arabian coast is generally flat while the Persian shore is hilly and precipitous. The Tigris and Euphrates rivers drain into the Persian Gulf. Many islands, ranging in size from mere uninhabited rocks to fairly large ones 70 mi. long, are scattered through the gulf.

PERSIAN LANGUAGE, the principal modern language of the Iranian branch of the INDO-IRANIAN linguistic group of INDO-EUROPEAN.

This language is derived from Middle Persian or PAHLAVI, and thus ultimately from OLD PERSIAN, and is the vehicle of a rich literature from the 9th century onward (*see also* PERSIAN LITERATURE), its development being characterized by a gradual simplification of sounds and morphology. Modern Persian declension possesses only one case in the singular and one in the plural, but in conjugation it distinguishes separate stems for present and past, as *kun-am*, "I do," *kard-am*, "I did," the former based on the old aorist, and the latter on the old past participle (Old Persian equivalents *akunam*, *kartam mana*, "done of me"). Persian is an easy language except for the numerous elements which it has borrowed from ARABIC since the introduction of Islam, so that a good knowledge of it presupposes considerable acquaintance with Arabic.

Persian is spoken throughout Persia with the exception of its northwestern province of Azarbaijan, where a Turkish dialect prevails. Side by side with the literary language, which came originally from the province of Fars, a number of dialects, roughly grouped as Caspian, Central and Pamir, are used outside the towns, in addition to local languages, such as KURDISH and BALUCHI. With some peculiarities, Persian is also the official language of Afghanistan and of the small Soviet republic of Tajikistan, which has gathered up the Iranian elements of Turkestan between Bukhara and the Pamirs.

V. M.

BIBLIOGRAPHY.—P. Horn, "Neupersische Schriftsprache," in W. Geiger and E. Kuhn, *Grundriss der iranischen Philologie*, 1901; J. Platts and G. Rankin, *Grammar of the Persian Lan-*

guage, 1911; D. C. Phillott, *Higher Persian Grammar*, 1919; W. St. Clair-Tisdall, *Modern Persian Conversation-Grammar*, 2d ed., 1920.

PERSIAN LANGUAGE, MIDDLE. See PAHLAVI.

PERSIAN LANGUAGE, OLD, an extinct language of the West Iranian division of the INDO-IRANIAN group of the INDO-EUROPEAN linguistic family, preserved in numerous glosses, scattered words in parts of the Bible dating from the Persian period, ARAMAIC papyri from Elephantine in Egypt, and late Babylonian documents. It appears especially in CUNEIFORM inscriptions, chiefly historical in content, of the Achæmenians from 521 to 338 B.C., the most important being those of Behistun, Persepolis, Naqsh-e Rostam and Susa, usually with parallel versions in Babylonian, New ELAMITIC and (very fragmentary) Aramaic. The language shows traces of dialect-mixture and has already become very corrupt in the later documents, whereas in the earlier inscriptions it essentially resembles AVESTA. It was spoken in the area roughly corresponding to the modern region of Fars in Persia, and was the source of PAHLAVI and standard Modern PERSIAN. L. H. G.

BIBLIOGRAPHY.—F. H. Weissbach, *Keilinschriften der Achameniden*, 1911; H. C. Tolman, *Ancient Persian Lexicon and Texts*, 1908 (Supplement, 1910); A. Meillet, *Grammaire du vieux perse*, 1915; V. Scheil, *Inscriptions des Achéménides à Suse*, 1929; R. G. Kent, *The Recently Published Old Persian Inscriptions*, 1931.

PERSIAN LITERATURE, the literature written in modern Persian inspired in large measure by ARABIC models, and more conspicuous for poetry than for prose. Except for a few fragments, the earliest productions have vanished, and the literature practically begins with one of the great epics of the world, the *Shāhnāmāh*, or "Book of Kings," of Firdausī, who completed it early in the 11th century. This is a history of Iran as known in legend, written to glorify the ancient heroes of Persia, and inspired with true poetic spirit and deep patriotism. It is, moreover, singularly simple in style for a product of the Near East, and betrays its anti-Mohammedan sub-feeling by exclusion, so far as possible, of Arabic words, and by laudation of ZOROASTRIANISM.

The *Book of Kings* formed the model for a number of lesser known epics, and Firdausī himself also wrote a poem on the love of Joseph, the Mohammedan ideal of manly beauty, for Zulaikha, the wife of Potiphar, a theme treated by Nizāmī and Jāmi as well. The master of the love-epic, however, was NIZĀMĪ (1141-1203), as in his poems on Chosrū and Shīrīn, and on Lailā and Majnūn, or in his *Haft-Paiḡar* ("Seven Images"), stories told to the famous Bahram Gor by his seven queens.

There is, moreover, a strong mystical vein in Persian poetry which finds philosophical expression in SUFISM and in the platitudes of modern Bahaism. In the "Bird-Parliament" (*Mantiq-at-tair*), of Farīd-ad-Dīn 'Attār (1119-1230), and especially in the voluminous poems of Jalāl-ad-Dīn Rūmī (1207-73), the burning love of the soul for God, and its longing that it may become nothing so that it may be absorbed in

Him who alone truly exists, is set forth with deep devotion and true poetic beauty. A middle course here was taken by Sā'dī (1184-1291), the author, among other works, of the "Rose-Garden" (*Gulistān*) and "Garden of Delight" (*Bustān*), the former, predominantly in prose, the first product of Persian literature to be translated into an Occidental tongue (by Olearius under the title of *Persisches Rosenthal*, 1654), and both collections of tales with a practical or moral application. A special genre is found in the epigrammatic quatrain literature, made familiar to the western world by the *Rubāyat* of Omar Khayyām (d. 1123). This form of verse is not found in Arabic, but seems to be a Persian invention, unless, indeed, it was ultimately inspired by the Indian fondness for quatrains as exemplified, for instance, in the *Centuries* of Bhartrihari (see SANSKRIT LITERATURE). Whether Omar's quatrains are to be read in their cynical and skeptical outward meaning, or in a deeper mystical and Sufistic inner sense, is difficult, if not impossible, to determine.

Passing over the court-poetry, with its fulsome and artificial laudations, one finds the master of the Persian lyric in HĀFIZ (d. 1389), who may likewise be interpreted mystically, and who inspired Goethe's *West-östlicher Divan*. There is, besides, a wealth of folk-poetry, much of it in dialect, which is still insufficiently known: and one example of a passion-play in honor of the Shi'ite martyrs, Hassan and Husain, the other "Persian" dramas being derived from Turkish sources.

Prose has been cultivated as well as poetry, as in Sā'dī's *Gulistān*, already mentioned, and Jāmi's *Bahārīstān*, or "Abode of Spring." Stories of all types form a favorite theme. The earliest stratum of the *Arabian Nights*, as is well known, is but an adaptation of a Persian version of an Indian original, other productions of similar, but original, character being the *Anvār-i-Suhailī*, or "Lights of Canopus," of Vā'iz Kāshifī (d. 1504). History is the subject of numerous works, such as the "Selected Histories" (*Tāwīkh-i-guzīdah*) of Qazvīnī (d. 1330) or the "Garden of Purity" (*Raudhat aṣ-Ṣafā*) of Mirchond (d. 1498); and memoirs, biography (especially of mystics), encyclopedias and works on geography, medicine and theology are likewise represented. In the modern period, however, Persian literature has little of worth to show, though an exception may perhaps be made in favor of the diaries of the travels of Shah Nāṣir-ad-Dīn (d. 1896). See also ARABIC LITERATURE.

L. H. G.

BIBLIOGRAPHY.—I. Pizzi, *Storia della poesia persiana*, Turin, 1894; H. Ethé, "Neupersische Literatur," in *Grundriss der iranischen Philologie*, ii, 212-368, Strasbourg, 1904; E. G. Browne, *Literary History of Persia*, 4 vols., 1928.

PERSIAN WARS, a series of unsuccessful invasions of Greece by the Persians, from 490 to 479 B.C. The invasions were the result of the assistance rendered by the Athenians to the rebellious Ionians. The first expedition in the reign of Darius the Great was a sea attack on Athens in 490 B.C. The Persians landed near Marathon in Attica, and were decisively

PERSIAN ART



HUNTING SCENE

* Persian print of the School of Sultan Muhammad (middle 16th century). In the Metropolitan Museum of Art.

beaten by the Athenians. Darius's successor, Xerxes, in 485 B.C. began three years of careful preparation for a second invasion of Greece. He gathered a large fleet and an immense army, and made various political alliances for the purpose of depriving Greece of external support. In 480 B.C. he sent his fleet westward along the northern Aegean Sea and the bulk of his army by way of the Hellespont. The Greek fleet was dispersed at Artemisium. The heroic resistance at Thermopylae was of no avail, Athens fell into the hands of the Persians, and the Greeks were trapped at the Isthmus of Corinth and in the Bay of Salamis. Here, however, the fortunes of war turned, and the Greeks succeeded in completely overwhelming the Persian fleet in the decisive BATTLE OF SALAMIS, 480 B.C. In the following year the Greeks completed their task by defeating the Persians in the Battle of Plataea, in Boeotia, thus freeing continental Greece from the danger of Persian conquest. In the same year the victory of the Greeks over the Persians at Mycale, in Asia Minor, foretold the liberation of both sides of the Aegean from Persian influence. See also GREECE, ANCIENT; PERSIA, ANCIENT.

PERSIUS FLACCUS, AULUS (34-62 A.D.), Roman poet, was born in Etruria in 34 A.D. He came of a good family and as a youth went to Rome to study with the most distinguished masters. Becoming imbued with the Stoic philosophy, his satiric verse was often reproachful of the moral delinquencies of his day. His style was far from clear, but occasionally he turned phrases that later grew into literary epigrams and are in use to-day. During the Middle Ages, probably because of his ethical tone, he was a favorite author in the schools. Frequently his language is the reverse of elegant as he affected to write in the speech of the ordinary man. Persius died in 62 A.D.

PERSONALITY refers to the total make-up of an individual; it represents the important dimensions in which we differ. Physique is the composite name for the type of build of the bodily features; it would be convenient to have the word *psychique*, or build of personality, to indicate the same for the mental features. Physique itself enters into personality; it includes the bodily component, the skeletal and tissue structure, the balance of physiological systems, the quality and working of the sense organs and muscles, and all the supporting organic factors. A special place may be assigned to the glands by reason of their conditioning of elemental vital functions. Dr. Berman sets forth this thesis in *The Glands Regulating Personality*. There are the physical or organic components of personality; there are next the primary, instinctive, affective sources of energy and its direction. The strength and quality of instinctive urges and emotional drives are fundamental factors of temperament. The physical personality or physique presents constitutional factors, strengths and weaknesses alike; the temperament is the psychic constitution or disposition.

The Sources of Personality. Temperament is an ancient term to which modern psychology gives a

more precise meaning. That emotional susceptibility is a vital phase of it was recognized from the outset. A conspicuous basis of temperament is a sensitive organization commonly called nervous; there are varieties of nervous temperaments. As temperament appears in exaggerated expression in the neuroses, there may be recognized an hysterical temperament, and a neurasthenic temperament, both over-sensitive. Contrasted with it would be the sluggish, apathetic responsiveness which was called phlegmatic in the older classification, and meant of a low type of sensitiveness and a low energy of response.

But temperament is never a matter of more or less; it implies organization and balance. The core of the temperamental composite is the susceptibility to emotional stress. In all behavior the emotions concerned are specific; susceptibility to anger and to fear are distinct. The part each plays in temperament is equally distinctive. Hysterical anger and neurasthenic fear are characteristic. (See ABNORMAL PSYCHOLOGY). Equally the susceptibility to sympathy or love gives a temperamental set; it gives meaning to such phrases as warm hearted or cold blooded, or to the favorite Italian term to indicate likeableness, *simpativo*. The emotional component in personality appears in the range and depth of susceptibility to the sex urge. This exercises a pervasive influence over the entire personality. Though specific, it affiliates with other emotional qualities, of which the parental, especially the maternal, relation is prominent. But as the personality itself is profoundly and pervasively affected by the fact that the person is man or woman, so also is the personality of each affected by the responsiveness to the relations between the sexes.

Emotions develop in the social setting; they reflect self and react upon the self-feelings which shape personality from another direction. Our prides and shames, our desires and their satisfactions, our efforts to secure esteem, possessions, station, recognition, fuse into an organized set of goals or ambitions reflecting the temper of the personality. These, though derived from instinctive urges, enter into the composite formulae of personality. They all compose the intimate personal and private life, which reveal the basic personality traits far more authentically than do the public activities, however prominent these may become in an elaborate social culture. Temperament is ever basic to character, its issue. (See CHARACTER, PSYCHOLOGY OF.)

Psychological Types. It is consequently in this composite of organic supports, affective dispositions and socialized emotional expressions that psychologists have sought the types of personality, and have selected quite naturally the temperamental types. The distinction made by William James between the tough minded and the tender minded, has been more acceptably termed *extravert* and *introvert* by Jung. The *extravert* is the more normal type and the more common; he enters whole-heartedly into the game of living, finds zests in occupation, is a good mixer, generous, open, not oversensitive. The *introvert* is fun-

damentally sensitive, which trait, when combined with reflection, makes for hesitancy, doubts and inhibitions; these impede the free release of social trends. Expressed emotionally, the introvert is withdrawing and timid; in his competition with others he may be self-detracting and develop a sense of inferiority. By contrast the aggressive personality on an extrovert basis may be overconfident with too ready self-assertion. An individual may be extraverted in some phase of his nature, introverted in others; and either trend may show itself dominantly at one or another level. At the sensory level, the introvert is sensitive to fine distinctions of form, color, tone and taste in the aesthetic life. At the emotional level he is sensitive to shades and grades of delicate sentiment and regard. At the reflective level he is sensitive to the critical judgment and logical values of ideas. Jung develops these types in minute detail.

With the characteristic temperamental types thus recognized in a new setting, the attempt has again been made to associate such psychic assets and liabilities with distinctive types of physique. The relation of physical to mental types is a legitimate inquiry, however baseless the ambitious attempts to read the latter in the former. The ancient temperamental types which referred them to dominance of humors was fanciful; but the composite influence of glandular balance is a scientific conclusion, however difficult in application. The pseudo-systems of character reading that speak of the thoracic, osseous, visceral and muscular types proceed upon the similar assumption that the preponderant development of the solid tissues in terms of the major physiological systems determine the type. That there is a comprehensive influence of physical type upon temperamental type is sufficiently indicated despite the variability of the relation as individually applied. MacAuliffe has attempted to relate these types to constitutional traits and distinguishes the respiratory, digestive, muscular and cerebral types, recognizing also several mixed varieties. This is an attempt to find a scientific basis for a distinction as yet lacking adequate support. Kretschmer's conclusions are based on elaborate measurements and derived from extensive observations on types of mental disorder. In physique he distinguishes between the pyknic or stocky, the athletic and the asthenic type, finding the first more constantly associated with one form of mental disorder known as manic depressive insanity, and the two latter physiques associated with another variety of mental liability, of which *dementia praecox* is a common form. This idea of detecting a temperamental trend in a liability to disorder is suggestive. It leads to a distinction between a cycloid type of personality characterized by large fluctuations in emotional mood, and a schizoid type, which harbors the making of dissociated states as well as of liability to the psycho-neuroses, to hysteria and to neurasthenia particularly. The evidence is conveniently reviewed by E. Miller in *Types of Mind and Body*, 1927.

The intellectual component in personality plays a

variable rôle. Reflection may dominate. The intellectuals direct their aims and pursuits by one standard; the unreflective, conventional masses by another. Both are subject to the social setting of institutions. The religious or artistic or reflective attitude may dominate a personality. Conservatives and radicals reach their positions alike by temperament and by reflection. With temperament as the emotional trend, character becomes the resultant expression of experience and the reflective direction of behavior. Character appears in the principles and codes accepted and followed in behavior. Together temperament and character compose personality. Accordingly, personality is an achievement, however natural an issue. From childhood up, the gradual change in the play of motives and the perspective of their importance develop a personality that matures and alters with the ages of man, and is strongly affected by the social environment. To become properly mature is itself a test of a stable personality.

The Concept of Personality. Though the content of personality inevitably remains somewhat vague, these approaches indicate the direction in which a helpful concept of its origin and nature may be found. Older and readier solutions abound. The attempt to read traits by bodily signs without due distinction between the inherited and acquired proceeds upon the erroneous assumption that a few clues reveal the whole. They neglect the central fact that personality is an integration, a composite interplay of factors inherent in the organism, but largely developed and matured by the selective reactions of experience to the social system under which the individual operates.

"Personality" says Leary, "is an all-inclusive term for all that a human being has, is, or can do, feel, think or wish." It is the working organization of components which must be thought of as structural, hereditary, fixed by nature within the organism, which impart a set, a balance, a perspective of the common human drives and dynamisms, but as modified, reshaped, directed, controlled by the complicated social and educational experiences from the early formative period through the increasing years when patterns of behavior are more reflectively chosen and followed as goals and ideals.

A convenient inclusive word for the first order of molding forces of personality is disposition; for the second order conditioning, not in the limited sense as used by some behaviorists, but generally to include environmental influences supplied by social codes and pressures. How these conditioning forces act selectively depends not a little on the dispositioning provided by the personal temperamental equation. Personality retains a more intimate reference to the dispositioning factors, while yet recognizing how largely, especially in complex forms of social living, the issue is shaped by the conditioning factors. The study of personality is coming to occupy a central place in modern psychology. The concept, though it remains indefinite in its contours, can be brought into relation

with the demonstrable components of the human individual.

J. J.

See R. G. Gordon, *Personality*, 1926; Leary, *Modern Psychology, Normal and Abnormal*, 1928.

PERSONAL PROPERTY consists of chattels personal and chattels real. The rules governing both are much simpler than those regulating realty. There is no feudal tenure, though the leasehold pseudo-“estate” is incumbered from its landed associations with various medieval subtleties. No estates exist (with slight exceptions) in chattels personal. Limited legal interests are creatable in them by BAILMENT; also equitable interests corresponding to, but vastly simpler than, estates in land. Transfer of title by sale is simpler than conveyances of land. All of an intestate’s personality descends to his personal representative and is distributed, after settlement of the estate, among the next of kin as defined by statute.

The law’s protection of interests in CHATTELS has long been intense and satisfactory; notwithstanding that, neither equity nor non-equity law treats them, generally, as unique, because lacking land’s one-time social and political significance. They are not (unless actually unique) protected against threatened injury, are much less surely recoverable in specie, and money damages only are given for breach of a contract for title. Nevertheless, the aggregate value of chattels personal to-day is probably vastly greater than that of landed interests, including leaseholds. The variety of tangible chattels has, of course, infinitely increased in modern times. To-day, also, enormous importance has been acquired by non-tangible personality; such as PATENTS and COPYRIGHTS, TRADEMARKS, corporate STOCK, BONDS, COMMERCIAL PAPER, other credit claims, and rights of action to recover damages.

Very recently there have been great changes in WAREHOUSE RECEIPTS and BILLS OF LADING, transfers of these instruments of title tending to override title transfers of the actual chattels. See also PROPERTY.

F. S. P.

PERSONA NON GRATA, the condition of a DIPLOMATIC REPRESENTATIVE who is unacceptable to the state to which he is accredited. Thomas Jefferson declared as Secretary of State that as a general rule no nation had the right to keep an agent within the limits of another without the other’s consent. International comity forbids even the appearance of coercing a friendly government to retain a foreign representative declared by it to be *persona non grata*, or unacceptable. A mission which is unacceptable may be terminated in several ways. The minister may resign, he may be recalled, the receiving state may request his recall, the receiving state may refuse to receive him, or he may be dismissed. C. E. MA.

PERSONIFICATION, a kind of METAPHOR in which inanimate objects or abstractions are regarded as human and alive, as when Liberty is considered a goddess, or Death a human being. If properly used, personification can stimulate imagination and lend

much vividness and concreteness to abstract ideas, but it can easily become meaningless and even ridiculous. Its ultimate origin is doubtless to be sought in ANIMISM.

BIBLIOGRAPHY.—H. Blair, *Lectures on Rhetoric and Belles Lettres*, 1820, A Bain, *English Composition and Rhetoric*, 1872.

PERSONNEL MANAGEMENT, the name given to that branch of the top managerial staff of an organization which is primarily concerned to aid in improving the relations between the employees and the organization; and to formulate policies and procedures which will enlist the energies, interest, and goodwill of all the workers in the organization to the end of forwarding its defined objectives with a minimum of effort and friction and with due regard for the welfare of the workers.

Explicit emphasis should be given to the point that as an executive function this responsibility is considered to be a distinct one of equal functional importance with such other management functions as PRODUCTION (see SUPPLY AND DEMAND), sales and FINANCE. It is, however, largely a staff function in the sense that its operating responsibilities are limited and its most important function is to work in an advisory and educational way with all the rest of the executive group.

A brief description of the activities usually assigned to a personnel department will suggest the extent to which its responsibilities are of a staff character and will show those in which it operates as a line department. While there is no complete standardization of practice or terminology, the following activities in a well organized company are typically placed under the personnel executive: selection and placement, job instruction and general training, health and safety, service or welfare features, supervision of joint organized dealings, personnel research.

In companies employing approximately 1,000 workers and over, the staff executive responsible for this work is typically on an executive level with other staff department heads. He may bear the title Personnel Vice-President, Personnel Manager, Industrial Relations Manager, or he may be Assistant to the President in Charge of Personnel.

In small organizations the chief executive or one of his immediate associates may devote as much time as necessary to the supervision of the several personnel functions delegating specific work to such subordinates as an employment manager, a training director, safety engineer, company nurse and the like.

In well managed organizations, broad personnel policies are usually determined by the general staff executive organization on which the personnel executive is represented. The personnel manager himself is usually responsible for the formulation of ways and means of carrying out such policies; and under his supervision are organized such special operating divisions as employment, training, health and safety and others depending upon the elaboration of personnel procedures.

It is obvious, of course, that on matters of the

selection of the staff, the proper methods of training, determination of terms of employment, and the supervision of right working conditions, the personnel department must work in close conjunction with all the other departments of the organization. In addition to these operating responsibilities, an equally important part of the function of the personnel executive is to act as an educational influence in being sure that all members of the executive and supervisory staff conduct their personal and group dealings with employees on as harmonious and effective a basis as possible. It is well recognized that the effectiveness of the personnel policy of any organization is limited by the sympathy and insight with which that policy is interpreted in action by all the official representatives of the company in their dealings with the workers.

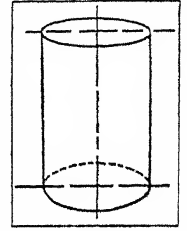
Historically, personnel management has come to be recognized as a distinct and unique executive function as the result of an evolution in which the following activities were independently developed in different companies and industries in the United States down to the beginning of the World War. The forces which contributed to the gradual recognition of a separate function were vocational guidance, corporation training, company medical work, safety work, COLLECTIVE BARGAINING with trade unions (see TRADE ORGANIZATIONS), labor legislation, scientific management as formulated by Frederick W. Taylor and his followers, and miscellaneous activities formerly referred to as welfare work. Prior to the War, a few companies had already placed a high executive in special charge of this work. Today at least 500 large companies have a major executive devoting full time to supervising the personnel function with the necessary specialized staff under his direction. And around 2,000 among the companies with less than 1,000 employees have developed in an intensive way a variety of the personnel functions. O. T.

PERSPECTIVE (Latin *perspicere*, to see through), the expression of the appearance of solids by means of drawing upon a plane surface. In perspective an object is drawn not as it really is but as it appears to be. Looking at a landscape through a window helps the artist to visualize the landscape as a picture and to comprehend the relative placement of all the objects therein, their apparent angles as related to the vertical and horizontal edges of the pane of glass, the angle of the axes of circular objects in relation to the vertical and horizontal, and the variations of distinctness of forms, and of color and shade, due to distance and to the interruptions of atmosphere.

The ability to construct a drawing in perspective is part of the necessary equipment of the draftsman and the painter. Perspective is defined as *linear* when the depiction is of the outlines of solids, and as *aerial* when it is a matter of the atmospheric variations that indicate relative distances. The first is a development of geometry; the second concerns visibility. Architectural drafting demands a comprehensive knowledge of solid GEOMETRY. The pictorial

draftsman and the painter require only what is termed *simple perspective*, or the representation of what is seen as it is seen; and such drawing is named *pictorial representation*. The *horizon* is the height of the onlooker's eye and is the basis of operation in the making of a perspective drawing. It is a plane surface extending away from the onlooker as far as his eye can reach. Every object that he can see is either wholly or partly above or below his horizon. He reckons the proportionate distance of points above or below his horizon.

A cube has six faces and each of them is a square and all of them are of equal dimensions. One may see three faces of the cube, if it is opaque, or two, or only one. If it is of glass one may see all six faces, and in this instance the faces appear to be varied as to shape and measurements. The face of the cube that is nearest appears to be larger than the face further away. This matter of appearance is the essential consideration in making a drawing in perspective. The only object that presents no varying appearance of contour with every change of position is a sphere.

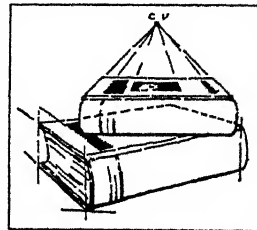


PERSPECTIVE DRAWING OF A CYLINDER

It will be observed that the horizontal edges of objects, not perpendicular to the line of sight, appear to be tending upward if below the eye level, or downward if above the eye level, although actually these edges are horizontal; that lines of objects which are in reality parallel seem to approach toward each other as their distance increases; that circular surfaces when not perpendicular to the line of sight appear as ellipses, from certain points of view becoming so narrow that they appear only as straight lines.

Looking along a straight street it will be seen that the upper horizontal lines of the buildings appear to be descending as the distance increases, and their lower horizontal lines to be ascending, these upper and lower horizontals all tending to a common point on the horizon.

From these appearances, which are opposed to the actualities, two rules are derived for the employment



COURTESY JOSEPH CUMMINGS CHASE
PERSPECTIVE DRAWING OF BOOKS

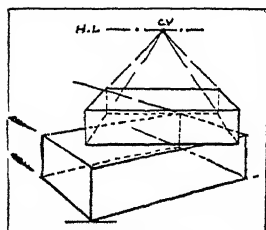
of perspective in pictorial representation: (a) all parallel horizontal lines seem to converge toward a point on the horizon called a *vanishing point*; and (b) all vertical lines are drawn vertical.

A camera directed upward photographs a tall building with its vertical lines converging, but the draftsman does not so draw them; he draws all vertical lines vertical in accordance with the second of the two rules stated. This is for the sake of an effect of reasonableness.

The *center of vision* (C.V.) is a point on the hori-

zon precisely in front of the direction of the gaze of the onlooker; this direction is termed the *line of sight*.

If the front edge of a horizontally placed rectangular object, as, for instance, a book, is perpendicular to the line of sight, half on either side of the line of sight, the right and left receding edges of the object appear to be converging upward toward a point on the horizon, namely, the vanishing point. In this case the vanishing point is identical with the center of vision.

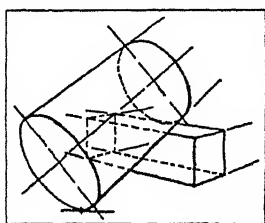


COURTESY CUMMINGS CHASE

PERSPECTIVE VIEW OF ONE RECTANGULAR SOLID RESTING ON ANOTHER

This is indicated in the accompanying illustration which also shows that the lower of the two books, the front edge of which is not perpendicular to the line of sight, has parallel right and left receding edges that converge toward a different vanishing point, but also on the horizon.

When objects are not horizontal, but oblique, their parallel lines seem to converge but the vanishing point of their convergence is not on the horizon line. This is illustrated in the accompanying drawing of a cylinder resting obliquely upon a rectangular object.



PERSPECTIVE VIEW OF CYLINDER AND RECTANGULAR SOLID

J. C. C.

PERSPIRATION, or sweat, the moisture secreted from glands in the skin. The sweat glands are found over practically the entire skin surface. The chief function of the sweat seems to be the regulation of the body temperature, the evaporation of sweat from the body surface causing loss of heat. Perspiration also supplements kidney excretion.

The sweat is made up of water containing small amounts of inorganic salts, largely sodium chloride, with small quantities of phosphates and sulphates, the organic substances urea, uric acid, creatinin and traces of others.

Excessive perspiration is observed in diseases like tuberculosis and rheumatic fever; fetid perspiration is due to decomposition of the sweat.

PERTH, capital of WESTERN AUSTRALIA, an attractive city situated on the Swan River estuary 12 mi. from its port, Fremantle. The population of both in 1929, including suburbs, was 202,888, or almost 50% of the entire population of the state.

Perth has wide, well-planned streets and a number of imposing buildings, including the House of Parliament, the state university and two cathedrals. King's Park (1,000 acres) on a hill overlooking the city, possesses great natural beauty. A settlement was founded here in 1829, and the city was constituted in 1856. After the discovery of gold in the colony the progress of Perth was rapid.

PERTH, a royal burgh and county town of Perthshire, Scotland, situated on the Tay, 32 mi. northwest of Edinburgh. The parks of North and South Inch lie on either side. A modern, well-built city, it has little to remind of its history early identified with Romans and Celts. The wealthy monasteries, castle, and the house where many Scottish parliaments met, have all disappeared in the various sieges. There is, however, the restored 15th century church of St. John the Baptist, the scene of one of John Knox's inflammatory sermons in 1559. Modern Perth carries on the dyeing and kindred industries instituted by the old town. Pop. 1921, 33,208; 1931, 34,807.

PERTH AMBOY, a port of entry and city of Middlesex Co., N.J., located on the Raritan River and Arthur Kill at their convergence with New York Bay, 15 mi. south of Newark. It is served by the Pennsylvania, Central of New Jersey, and Lehigh Valley railroads, ferries to Staten Island and motor bus lines. Victory Bridge and Outerbridge Crossing, great highway bridges, connect it with South Amboy and Staten Island respectively. Because of its good harbor facilities it has extensive shipping interests with drydocks and shipyards. Perth Amboy is one of the important centers of the world for the refining of copper and silver and the manufacturing of clay products, and it has various other industries. Its manufactured products were valued at about \$273,400,000 in 1929. The retail business in 1929 amounted to \$24,472,471. Phillip Carteret founded Perth Amboy in 1664 and it became a city in 1718. Under the colonial government it was the capital of East Jersey and for a period served as the capital of the state alternating with Burlington. There are a number of interesting colonial buildings still standing. Pop. 1920, 41,707; 1930, 43,516.

PERTURBATIONS, in astronomy, the small deviations in the course of a planet or comet around the sun that are due to the attraction of the other planets.

PERU, a South American republic on the Pacific coast, bounded on the north by Ecuador and Colombia, on the south by Chile and on east by Brazil and Bolivia. Area 533,916 sq. mi., with about 100,000 sq. mi. in dispute. In 1927 the total population was estimated at 6,147,000.

Surface Features. The region has three major physiographic provinces characteristic of the west coast countries of South America within the tropics: a narrow coastal plain with tributary mountain valleys; a massive cordillera 200 to 250 mi. in width; and an *Oriente* or eastern region of dense tropical forest which includes more than half the land of the country. The coastal strip has a width varying from almost nothing up to 100 mi., but the average width does not exceed 30 or 40 mi., and this is not all level land. Low mountains or foothills appear everywhere, but among these are level lowlands of considerable extent, and there are alluvial valleys reaching well back into the mountains.

Climate. The climate has great variations. On the highlands there is a dry season from May to

October, when it is damp on the coast, while the chief precipitation above occurs during the dry, summer months on the coast. At an altitude of 7,000 ft. the climate is considered agreeable. At Lima, 8 mi. from the sea, the mean temperature is 66° F.

Irrigation. The rainfall is from 30 to 40 in. a year in the high Andes, and during January, February and March the mountain streams are at flood. They plunge downward several thousand feet in flowing a distance of 150 mi. or less and become heavily laden with silt and gravel eroded from the upper valleys. As they flow out upon the coastal plain their velocity is checked and their load is deposited in the form of alluvial fans and flood plains of considerable size. These flood plains and fans are the only agricultural lands of the coast of Peru. The Incas built irrigation works for controlling the flood waters and utilized them for the growing of crops. To-day, about 640,000 acres are wholly or partially under irrigation.

Guano Industry. Along the coast of Peru are many small desert islands extending from Pisagua, a Chilean possession, to the Lobos Islands, farthest north, a distance of 850 mi., where the guano birds congregate in enormous numbers. About 24 species frequent the islands and 12 or more nest upon them. A few, particularly the cormorants, pelicans and gannets, deposit most of the guano. Conditions favoring the collection of the deposits include the desert climate with no rain and abundant sunshine; and the cold waters of the Humboldt Current, carrying a great variety of plankton of animal and plant life, upon which feed enormous numbers of birds, including the guanay, a white-breasted cormorant. Some 200,000 tons of guano are taken each year; about 50,000 tons are exported yearly, the rest being used in domestic agriculture.

Forestry. Forest products except rubber have received little attention; export of tagua, which had greatly increased in recent years, fell off in the late 20's because of lowered prices. Rubber is almost uncultivated now because of the cheapness with which the plantation variety is produced in the Far East. On the eastern slopes of the Andes the coca shrub is grown. From its leaves the drug, cocaine, is made. The Indians chew the leaves almost constantly and derive from them remarkable powers of endurance and resistance to hunger, but the general effect upon the user is stupefying. Other forest products, which now receive little attention, include all kinds of valuable timbers, dye and other woods usual in a tropical forest.

Agriculture. The irrigated valleys yield two great commercial crops, cotton and sugar, and also a host of other products including corn, rice, wheat, barley, alfalfa, many vegetables and numerous tropical and subtropical fruits. The production of cotton, indigenous to Peru, was under 40,000 bales in 1900, but at present exceeds 200,000 bales. Of good grade, it forms a quarter of all exports in value. Sugar constitutes nearly a quarter of the total exports of the

country, supplies local consumption and furnishes about 60% of the alcohol made in the country.

Minerals. Peru was long the chief producer of petroleum in the continent, but has been surpassed by Venezuela. The oil fields are close to the sea, thus greatly cheapening the cost of marketing the oil. Seventy-five per cent of the output enters foreign trade; petroleum also furnishes nearly all the kerosene used in the republic and the fuel oil of the railways and factories of the coastal desert. Gold, silver, copper, vanadium and coal are mined in the Andes.

Transportation. Primitive transportation facilities prevail over three-fourths of the country, only 2,020 mi. of railroads being in operation. Two systems, the Central and the Southern, extend from the coast into the Andean region. In the coastal desert there is no longitudinal railway and no good motor roads. Scattered along the 1,400 mi. of coast line are 35 or more ports which handle the trade of the country. Only four possess harbors which can be called even fairly adequate.

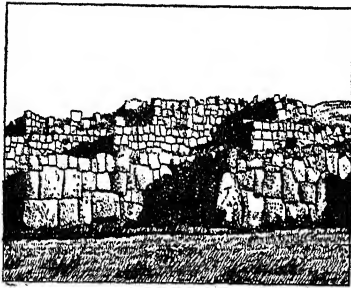
Inhabitants. Indians and mestizos constitute fully 82% of the population. The country lacks a middle class to span the wide gulf between the Indians and mestizos, who exist at the bottom of the scale of civilization, and the civilization embodied in the ruling class. The eastern lowlands are inhabited by many tribes of uncivilized Indians; and the highlands by Indians and mestizos who eke out a bare living in the niggardly soil of the isolated valleys and high pampas. In the coastal desert highly mixed mestizos provide the labor for agricultural operations in the irrigated valleys and for industries. The 600,000 whites in Peru, living mostly in the coastal cities and ports, constitute the ruling group as well as the controlling part of the industrial and commercial class.

Cities and Ports. LIMA is the capital and largest city of the country. It is beautifully situated in a valley which reaches away for 50 mi. to the foothills of the Andes. CALLAO, the port of Lima, is the most important in Peru and receives more of the imports of the country than all other ports combined. On the side of exports, Callao has no such predominance over the other ports. It is equalled or exceeded by Talara, the chief oil-shipping port. Mollendo is the ocean gate for southern Peru and a part of Bolivia. The other important cities are Arequipa; Cuzco, the ancient seat of the Inca empire; Chiclayo and Trujillo.

H. A. A.

PERU, HISTORY OF. Peru like Mexico was the seat of an extensive aboriginal civilization that had to be conquered before the Spaniards could initiate their permanent colonization. The story of the conquest of the Incas is told in detail in the biographies of ATAHUALPA and FRANCISCO PIZARRO. Pascual de Andagoya first heard of the Inca empire in 1522. Among others in the Spanish colony at Panama was Pizarro, who with two partners, DIEGO ALMACRO and the priest Hernando de Luque, continued the quest, and finally reached Peru in 1527. The Inca Mon-

archy had been divided between the two brothers Huascar and Atahualpa, a factor which favored the Spaniards when the final expedition got under way. In 1529 a contract was signed by the Crown with Pizarro in Spain, in which the conditions for an expedition to conquer the Incas were set down. In pursuance with this accord Pizarro sailed from Panama in 1531. At Tumbez he learned that Huascar had been defeated and imprisoned by Atahualpa. The latter was seized by the Spaniards at Cajamarca, and executed in Aug., 1533. Cuzco fell in the following November, and on Feb. 18, 1535 the city of Lima was founded by Pizarro, then governor. Almost immediately civil war broke out between the followers of Pizarro and those of Almagro. The latter was executed by Pizarro in 1537, Pizarro was assassinated in 1541, and Diego Almagro the Younger followed the way of his father in 1542. The last of the turbulent early conquistadors was Gonzalo Pizarro, who was finally defeated in 1548 after a four-year rebellion.



COURTESY AMER. MUS. OF NATL. HISTORY

PART OF THE GREAT FORTRESS OF SACSAYHUAMAN ON A HILL NEAR CUZCO, PERU

In 1544 the first viceroy of Peru came out from Spain, accompanied by the judges of the first Audiencia. Peru was to become an extensive kingdom and the brilliant center of Spanish activities in South America. It came to embrace all the territory now occupied by the Spanish-speaking republics south of Panama, except Venezuela. In 1559 the Presidency and Audiencia of Charcas were created, though subordinated to the authority of the viceroy at Lima. Quito was erected into an Audiencia in 1563. From 1569-81 Don FRANCISCO DE TOLEDO was the viceroy. During his term the Inquisition was established and the University of San Marcos, one of the oldest in America, 1551, was reorganized. At this time, too, English corsairs, beginning with Sir FRANCIS DRAKE, began their depredatory expeditions along the coast, to be followed by the Dutch in the next century. In 1585 the first printing press was established in Lima. In 1609 was formed the Audiencia of Santiago de Chile, subject to the viceroy at Lima.

Peru served as the base for numerous expeditions not only into the Pacific but inland as well. Many islands were discovered and rivers explored. From 1680-85 filibusterers from the West Indies ravaged the Pacific coasts of America, causing no little concern in Peru. With the dynastic change in Spain, 1700,

came many changes in the administration of the American colonies. In 1739 the first dismemberment of the old viceroyalty occurred. The viceroyalty of Santa Fé or New Granada was revived and definitely separated from Peru, and to it was attached the Presidency of Quito. The second dismemberment occurred in 1776 when Buenos Aires was made the capital of a viceroyalty which included the area covered by modern Bolivia, Argentina, Paraguay and Uruguay. Meantime an earthquake had destroyed Callao and wrecked Lima in 1746. In 1767 the Jesuits were expelled from Peru as from other parts of the Spanish Empire. From 1780-83 there took place the serious Indian uprising led by TUPAC AMARU II who was executed in 1781. His mantle passed on to Felipe Tupac who also suffered the death penalty in 1783. In consequence a new Audiencia was erected at Cuzco in 1787. In 1792 there appeared in Lima the *Diario Erudito*, claimed to be the first newspaper printed in South America, and the *Mercurio Peruano*, one of the first magazines or reviews. In 1778 the captaincy-general of Chile was made virtually independent of Peru. It was in the course of the expeditions of FRIEDRICH HEINRICH ALEXANDER VON HUMBOLDT in the years 1799-1804 that the Peruvian or Humboldt Current was discovered. This current accounts for many of the physiographic and climatic phenomena of Peru.

Independence Declared. From 1808 on to 1824 the history of Peru reflects movements in the Spanish Peninsula, where Napoleon had replaced the monarch by his brother, and those in the neighboring Spanish colonies where independence soon became the general objective. Most of Peru, however, as the seat of an ancient viceregal court and the home of many distinguished Spanish officials and families, clung steadfastly to the Crown, and became the refuge of Royalists and the last stronghold of the dying power of Spain in America. The Peruvian viceroy took it upon himself not only to repress liberating movements within his jurisdiction, but to send expeditions into those lands where the revolution against Spain had been successful. The defeat of the Spaniards in Peru therefore became the objective of two emancipatory currents. Their leaders realized that their own work would not be complete or permanent until every vestige of Spanish power had been eliminated from America. For the details of the movements leading up to the Battle of Ayacucho in 1824 see LATIN AMERICA and JOSÉ DE SAN MARTÍN, SIMÓN BOLÍVAR, ANTONIO JOSÉ DE SUCRE, BERNARDO O'HIGGINS and LORD THOMAS COCHRANE. On Jan. 23, 1826, with the capitulation of Rodil in Callao, the Spanish flag ceased to wave on South American soil and Peru was independent. With independence began a period of turbulence which it is unnecessary to follow in detail.

Peru had the distinction of having had both San Martín and Bolívar as Protector or President, the first serving in 1821, the year when independence was declared, and the second from 1823-26. During the next three years the Peruvians endeavored to free them-

selves from the influence of the Colombian soldiers brought by Bolívar and from the system the latter sought to impose. This involved a short war with Gran Colombia. From 1829-33 Agustín Gamarra sought to govern a politically troubled country. After two years of anarchy President ANDRÉS SANTA CRUZ of Bolivia came to play an important rôle in Peruvian politics. In 1836 he forced the Peruvians into a Peru-Bolivian Confederation which lasted until 1839. This was broken up partially by Chilean and Argentine intervention and partially by local dissatisfaction with it. From 1839-44 there was little order in a country where the military were predominant, serving primarily personal rather than public ends. In 1845 RAMÓN CASTILLA was elected President, and his régime was fruitful in reforms, order and relative peace. For 20 years he exercised a beneficent influence on the country. He reorganized the armed forces, introduced the telegraph and the first railroad, and bettered the finances of the country. It was in his time that the exploitation of Peruvian nitrates and guano became important. Castilla was reelected in 1855 after a brief absence from power. A short war with Ecuador took place in 1857. Three years later on the proposal of Castilla a new Constitution was adopted, which lasted until 1919.

Boundary Disputes. Friction developed with Spain over the latter's attempt to collect damages for injuries suffered by her nationals. In 1864 she seized the Chincha Islands, and in 1866-67 ensued a naval war with Peru and Chile, allied with Bolivia and Ecuador. José Balta was elected President in 1868. His term was distinguished by the construction of public works and by a large increase of the foreign debt. Railroads were also begun. After his overthrow in 1872, Manuel Pardo, the first civilian President of the nation, took office. Administration was somewhat decentralized, education fomented, and a census taken. The finances of the country were in a disastrous condition, and in order to relieve the situation Pardo began to exploit the nitrate fields of Tarapaca as a Government monopoly. A defensive alliance with Bolivia was signed in 1873. In 1876 Pardo was succeeded by Gen. Manuel Ignacio Prado, under whom finances went from bad to worse. In 1879 the War of the Pacific broke out, from which emerged the troublesome Tacna-Arica dispute (See LATIN AMERICA). Internally the period was one of the utmost political confusion. After the war Gen. Andrés Bvelino Cáceres, in 1885, as military dictator undertook the work of national reconstruction. In 1890 the republic's foreign creditors, organized in a Peruvian Corporation, cancelled the foreign debt in return for the transfer to it of the national railways and various other concessions. During this and succeeding terms a civilian party emerged, and in 1895 its leader, Nicolás de Piérola, assumed the chief magistracy. One of his greatest contributions was to lessen the power of the military by introducing reforms in the army and compulsory military service. He also placed the country on the gold standard. In 1899 all parties

agreed to the election of Eduardo de Romaña. An American concern built the railroad from Oroya to Cerro de Pasco during his term. José Pardo was President from 1903-08. Boundary questions with Bolivia, Ecuador, Brazil and Colombia became insistent, those with Brazil and Bolivia were settled by treaty.

Civilian governments followed each other with relative regularity. In 1908 AUGUSTO B. LEGUIA, who was to play a significant rôle in Peruvian life for a quarter of a century, became President and served until 1912, when he was followed by Guillermo E. Billinghurst. The latter was overthrown, and José Pardo followed in his stead in 1915. Peru broke off diplomatic relations with Germany in the course of the World War, was represented at the Peace Conference, and became a signatory to the Peace of Versailles and a member of the League of Nations. Leguia, elected again in 1919, assumed the Presidency by a *coup d'état*. In the same year a new Constitution was promulgated, which contained many provisions of a liberal social nature. Leguia had a vast program of public improvements for which he borrowed heavily from the United States. Despite many of the benefits of his régime, however, his methods were arbitrary and often despotic. When the economic crisis of 1929 developed Peru began to suffer, and much of the blame was laid to the too generous and extravagant expenditures of the President and to the heavy burden of the foreign debt. Lieutenant-colonel Luís Sanchez Cerro of Arequipa led a successful revolution against Leguia in 1930. Political disorder continued and Sanchez Cerro was forced to leave for Europe; but he subsequently returned and was elected Constitutional President of the Republic in 1932.

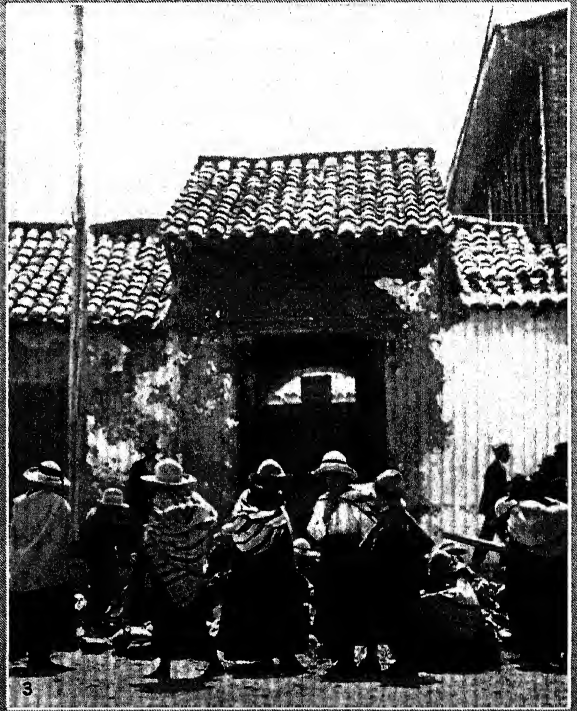
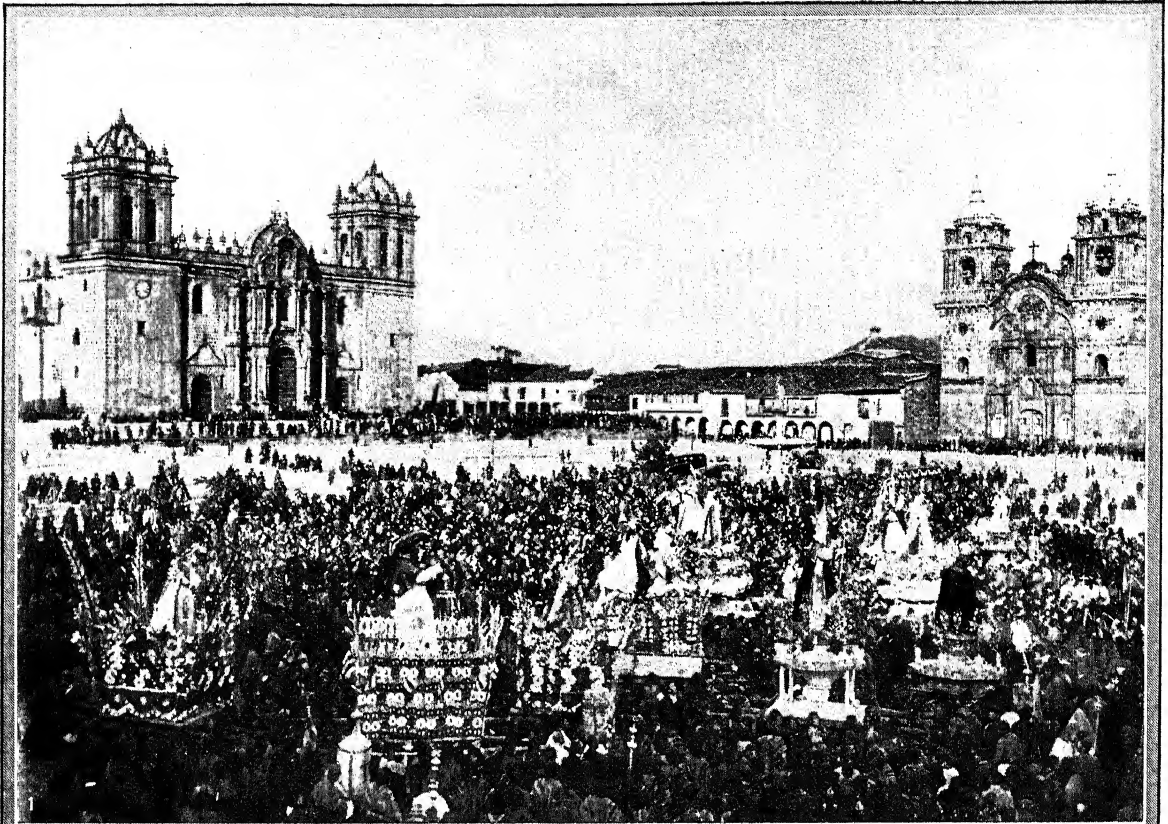
P. V. S.

BIBLIOGRAPHY—C. Wiesse, *Historia del Perú*, 1928; M. F. Paz Soldán, *Historia del Perú Independiente*, 3 vols., 1868-74; G. H. Stuart, *The Governmental System of Peru*, 1925; W. J. Dennis, *Tacna and Arica*, 1931; V. A. Belaúnde, *Nuestra Cuestión con Chile*, 1919; V. A. Maúrtua, *The Question of the Pacific*, 1901; W. B. Parker, *Peruvians of Today*, 1919.

PERU, a city in La Salle Co., northern Illinois, situated on the Illinois River at the head of navigation, two miles west of La Salle. River craft and two railroads afford transportation. Peru is important for its coal mines and zinc works. Its factories turn out alarm clocks, shirts, paint and many other products. The region is good farming country. La Salle Co. has three beautiful State Preserves: Starved Rock Park, Buffalo Rock Park and Shabbona Park. Peru was founded in 1830 and incorporated in 1845. Pop. 1920, 8,869; 1930, 9,121.

PERU, a city of north central Indiana and county seat of Miami Co., situated on the Wabash River, 72 mi. north of Indianapolis. It is located on three railroads and on Federal highways. A county museum of pioneer relics is here and three circuses make Peru their winter quarters. Trade is in general farm products of the surrounding territory and there are local industries. In 1929 the manufactures reached approximately \$5,000,000; the retail trade amounted to \$8,160,320. Peru established a town government

PERU



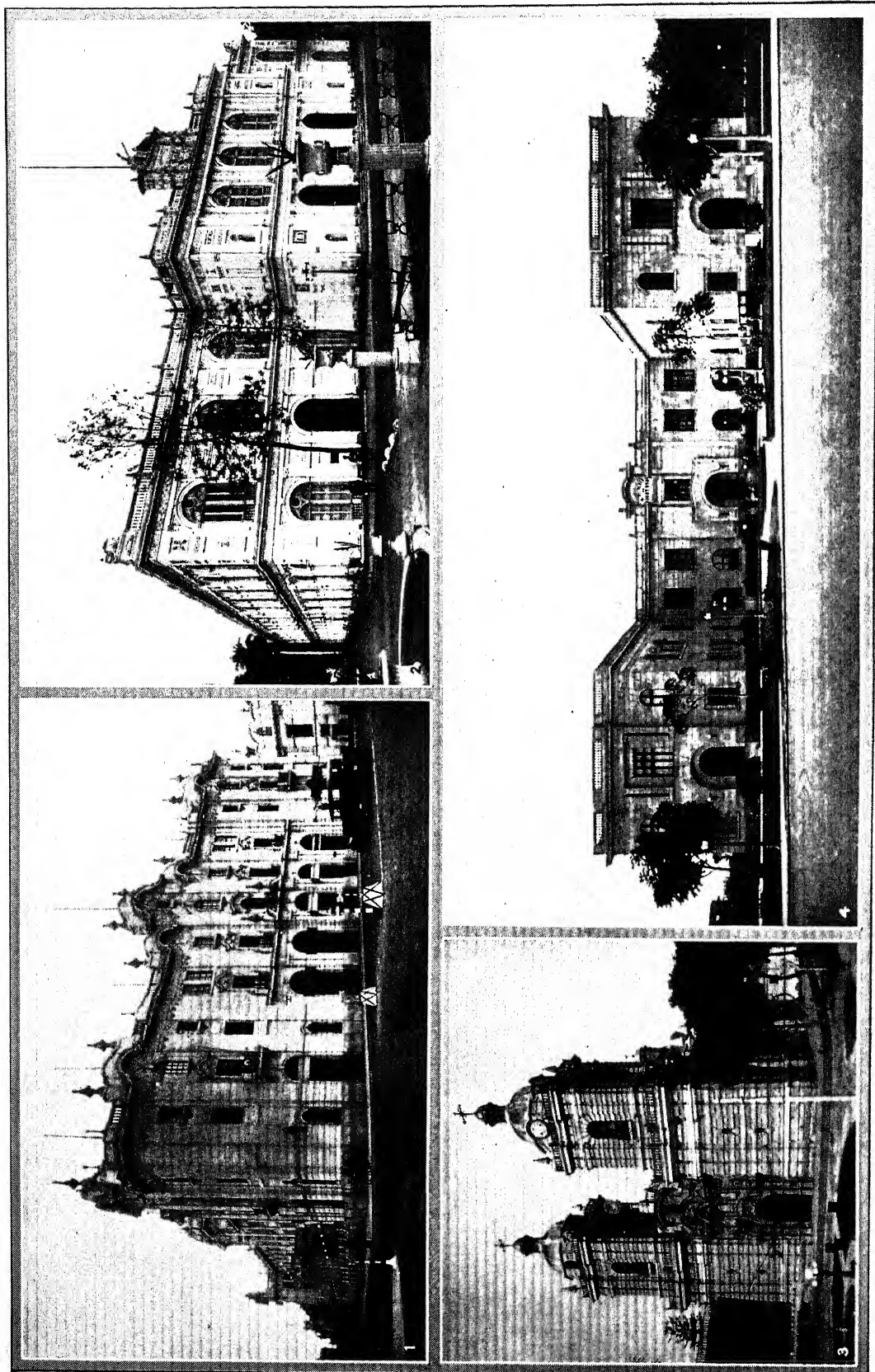
1, 3, COURTESY CONSULATE GENERAL OF PERU; 2, INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION

STREET SCENES IN CUZCO, LIMA AND HUANCAYO, PERU

1. Procession in the religious festival of Corpus Christi in the Plaza de Armas, Cuzco. 2. The Cathedral in Lima,

noted for its beautiful towers and Moorish façade. 3. Peasants before a Spanish colonial gateway in Huancayo.

PERU



IMPORTANT BUILDINGS OF LIMA, CAPITAL OF PERU

1. Lima's foremost hotel, the Bolivar.
2. The Municipal Palace with its plaza in the foreground.
3. San Francisco, the oldest church in the city.
4. Building of the Department of Public Works.

in 1842, and became incorporated in 1867. Pop. 1920, 12,410; 1930, 12,730.

PERUGIA, a city of central Italy, capital of the province of the same name in Umbria, the seat of a small university founded in the 14th century, and of an archbishop. It lies on a group of hills about 1,600 ft. above the valley of the Tiber. Portions of the Etruscan walls which enclosed the old town still remain. On the site of the former papal citadel is the Piazza Vittorio Emanuele affording a superb view of the Umbrian valley. Perugia was the seat of the famous Umbrian school of painting, whose greatest masters, Perugino and Pinturicchio lived there. The young Raphael worked in the former's studio. The most important churches are the 15th century Gothic cathedral; San Domenico, a Gothic building of 1304, containing the tomb of Benedict XI; the early Christian basilica of San Pietro; the Oratorio di San Bernardino with a superb polychrome façade; Sant' Angelo, dating originally from the 5th century; and San Severo, an old monastery, which has one of Raphael's earliest frescoes. Of the fine public buildings, the most noteworthy are the old Exchange, 1452-57, the Palazzo del Municipio, 1281, and other palaces, including the archiepiscopal residence. The ancient Roman *Perusia*, the city was an independent power in Umbria in the 13th-15th centuries, but in 1540, rent by internal dissensions, it had to surrender to the Pope. However, the struggle for independence continued under various leaders. In 1860 it became a part of United Italy. The chief manufactures are agricultural machines, silk and woolen goods. The trade is chiefly in agricultural products and cattle. Pop. 1931, 79,270.

PERUVIAN LITERATURE, the literature of the Republic of Peru, South America, which is treated under the title **LATIN-AMERICAN LITERATURE**.

PESARO, a seaport of Italy, capital of the province of Pesaro e Urbino, at the mouth of the Foglia River in the Adriatic, 19 mi. northeast of Urbino. One of its famous structures is the medieval Villa Imperiale. GIOACCHINO ROSSINI was a native of Pesaro where he established a school of composition. The city was ruled by the Malatesta family during the 14th century and by the Sforza house during the 15th century. In the 17th century Pesaro reverted to the Papal States. The chief neighborhood crop is figs. Pop. 1931, 42,549.

PESCARA, a town of east central Italy, the capital of the province of the same name, situated on the Adriatic Sea. It is the site of a famous 12th century Cistercian abbey. A railway joins Pescara to the city of Brindisi. Pop. 1931, 43,952.

PESETA, the monetary unit of Spain. Its par value is about 19.3 cents.

PESHAWAR, the chief city and seat of government of the Northwest Frontier Province, British India. The city, covering a large area, is encompassed by a mud wall, and is commanded by the Bala Hissar, a fort which crowns an eminence just outside the wall. Being an important strategical

point of India, a British garrison is stationed here to control the Khyber Pass and thus nearly all the trade between India and Afghanistan. Peshawar stands at one end of the route, Kabul at the other. The enlistment of frontier tribesmen in the British army has done something to curb their natural desire for raiding, a time-honored custom not yet dead. Cloth and firearms are the important manufactures. Pop. 1931, 111,233.

PESO, the monetary unit of Argentina, Chile, Colombia, Cuba, Mexico, Paraguay, the Philippines and Uruguay. The peso in these countries is equivalent at par to 96.48 cents, 12.17 cents, 97.33 cents, 100 cents, 49.85 cents, 96.48 cents, 50 cents and 103.42 cents respectively.

PESSIMISM, the belief that the world is bad and that existence is an evil, the opposite of **OPTIMISM**. Like optimism, it may be either metaphysical or moral, the former holding that at the very core of the universe there is a surd that runs throughout all existence. Moral pessimism applies to the nature of man, holding that he is essentially an evil creature. Probably the most notorious example of philosophical pessimism is found in **SCHOPENHAUER**. Christianity, with its doctrine of original sin, is allied with moral pessimism. Moral pessimism does not necessarily follow from such a metaphysical position. In fact it is quite possible to be an ardent meliorist ethically and still be tinged with metaphysical pessimism.

PESTALOZZI, JOHANN HEINRICH (1746-1827), Swiss educational reformer, was born at Zurich, Jan. 12, 1746. Always interested in the poor, he early showed an interest in social reform and naturally cast his lot with the revolutionary parties. After studying law and theology he turned to agriculture as the best means for remedying the lot of the down-trodden. At Neuhoof from 1775-80 he conducted the first industrial school for the poor. His efforts were misunderstood by both the children and their parents, and the experiment ended in failure. But it was the beginning of experimentation in education, and as such, it left its mark. The following 18 years were given principally to writing. In 1780 he produced *The Evening Hours of a Hermit* and the following year appeared his most important work, *Leonard and Gertrude*. Written in the form of a novel, this story showed how a simple woman by means of education could bring up a family in such a manner as to raise the standards of the whole community. His other important work is *How Gertrude Teaches Her Children*, 1801.

It was not until he was past 50 that Pestalozzi's active work as a teacher began. Influenced largely by **JEAN JACQUES ROUSSEAU**, he soon nevertheless saw the shortcomings of the negative philosophy of nature. First at Stanz in 1798 and then at Burgdorf from 1799-1805 he conducted model schools. At Burgdorf was born his idea of the object lesson, and here it was that he made the first serious attempt to "psychologize" education. Finally at Yverdon, in 1805, was begun his last great experiment. Here for a period

of 20 years Pestalozzi's work became the center of interest throughout the educational world. His inability to organize and to get along with his staff caused this brilliant experiment to go the same course as his others, and in 1825 he was forced to retire. Nevertheless his firm conviction that through education the world could be regenerated morally has lived after him. And he set in motion currents that have exerted a profound influence upon modern education and teacher training institutions. Pestalozzi died at Brugg Feb. 17, 1827.

PEST CONTROL MACHINERY, various devices used in spraying, dusting, fumigating and sterilizing applications for destroying insects. Spraying machines comprise a force pump, a tank and a hose and nozzle attachment. They may be powered by hand, by traction or by an internal combustion engine. Dusters, or dry-sprayers, ordinarily consist of blowers either hand or power operated. In the fumigation of plants, boxes or tents are used to retain the gases. In sterilizing work, or scalding, portable boilers are generally employed to heat the water and special sprinklers or sprays to apply it.

PESTERZSEBET, formerly Erzsebetfalva, a city in the Hungarian county of Pest, situated on the east bank of the Danube. A street railway connects the town with Budapest. The chief manufactures are machines, soap, metal and woven goods. Pop. 1930, 67,871.

PÉTAİN, HENRI PHILIPPE BENONI OMER JOSEPH (1856-), French marshal, was born at Cauchy la Tour, Pas de Calais, May 24, 1856. He was educated at St. Cyr and the École Supérieure de Guerre, was appointed to the general staff and in 1901 became a military instructor. In Oct. 1914 he was given command of the 33rd Army Corps, and penetrated the German lines in the Arras offensive 1915. He was rewarded with the command of the 2nd Army, which launched the Champagne offensive. In 1916 Pétain stopped the Crown Prince's furious attack on Verdun, and in 1917 was appointed Commander-in-Chief of French Armies. In the concluding campaigns of the war, he drove the Germans to the Ardennes. After the Armistice he was created a marshal and in 1929 was elected to the French Academy. He visited United States in 1931 to attend the sesqui-centennial celebration of the victory of the French and Colonial Armies at Yorktown, Va.

PETALUMA, a city in Sonoma Co., in western California, situated at the head of navigation on the Petaluma River, 35 mi. northwest of San Francisco; served by the Northwestern Pacific Railroad and bay and river craft. Dairying and poultry raising are highly productive industries in the vicinity. The city has incubator factories and a silk-thread mill, the first west of the Rockies. Petaluma was laid out in 1852, incorporated in 1858, and became a city in 1911. Pop. 1920, 6,226; 1930, 8,245.

PETER, ST., usually called in the Gospels, Simon Peter, was one of the most favored of the 12 disciples of Jesus, and under Christ the founder of the Chris-

tian Church. In the Gospels he plays many dramatic parts, as for example, in connection with his attempt to walk on the water to Jesus, his miraculous draught of fish, and, during the last hours of his Master, his denial of him thrice. Later Bible narratives tell us of his imprisonment by Herod in 44 A.D. and his contention with Paul at Antioch regarding the proper policy to follow in admitting Gentiles to the Church. Some scholars think that the most reliable history of this apostle is found in the Epistles of Paul, where we learn that he was the first to see the risen Christ, was one of the "pillars" of the church in Jerusalem, that he was accompanied by his wife on his missionary journeys, and eventually accepted Paul's views on the admission of the Gentiles. The ROMAN CATHOLIC CHURCH accounts him "the Prince of the Apos-



COURTESY W. M. OF ART

ST. PETER

French champlevé enamel plaque with applied figure, 1250-1300

ties," and traces its history and authority to him, believing him to have been the first bishop or Pope at Rome.

Tradition and legend have many things to say of the scenes of Peter's ministry after he left Jerusalem. Origen states that he labored in Pontus, Galatia, Bythinia, Cappadocia and Asia. Others find his field in Macedonia, Greece and Italy. Yet others state that he preached in North Africa, Egypt and Britain, or in Babylonia and Persia. Those who place his ministry in Rome sometimes assert that after 25 years, he was martyred there in the reign of Nero. Those who oppose this tradition affirm that he never was in Rome, and state that the tradition which located him there is not older than 160. He is reputed to be the author of two epistles in the New Testament, and to have influenced largely the author of the Gospel Ac-

CORDING TO MARK, whom Papias called "the interpreter of Peter." His death is celebrated with that of St. Paul's, on June 29, and in the most ancient of the church festivals, dating from the 3rd century.

PETER II (1715-1730), Emperor of Russia, was born Oct. 18, 1715, the son of the TSAREVICH ALEXIUS, and grandson of PETER THE GREAT. He was proclaimed sovereign May 18, 1727 and was crowned at Moscow the following year. His accession brought exile to the scheming politician Menshikov, and raised to power Dolgoruki, whose chief interest was the advancement of his own family fortune. On Jan. 30, 1730, the day he was to have been married to Catherine, daughter of Dolgoruki, Peter died of small-pox.

PETER, EPISTLES GENERAL OF, in the New Testament, consist of two letters, ascribed to Peter, one of the 12 disciples of Jesus, who tradition says became the first bishop or Pope of Rome and was martyred under Nero. The first letter is definitely addressed to "the dispersion in Pontus, Galatia, Cappadocia, Roman Asia and Bithynia." The ancient view, still held by many, is that the epistles are by Peter. The Pauline thought and language in it are understood to be intended to show that Peter and Paul were now working in unity, a clear lesson to the church addressed. Those who attribute the first letter to an author writing as late as 125 believe it to be an apology for Paulinism for the adherents of Peter, and doubt that the Galilean fisherman could command the Greek style of this letter. The second letter was early doubted. Jerome denies that Peter wrote it. Clement and Irenaeus know of only one letter. The second letter has had a place in the canon since the Council of Laodicea, 372. In the Christian churches both epistles are greatly esteemed for their exhortations on holiness.

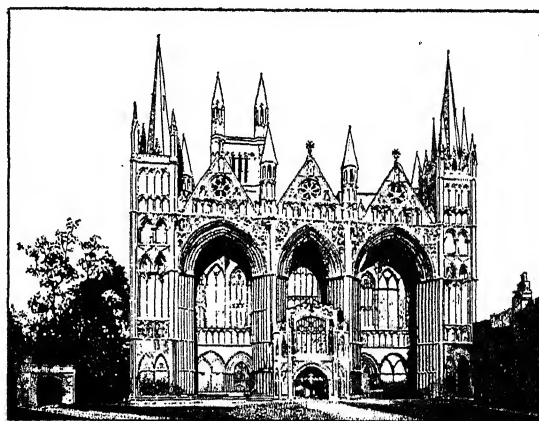
PETERBOROUGH, a city and municipal borough of Northamptonshire, England, situated on the Nene at the western border of the Fen country, 76 mi. north of London. It grew up about a 7th century Benedictine monastery founded at the then Medehamstede, and dedicated to St. Peter, St. Paul and St. Andrew, from which was derived the later name of St. Peter's Burgh. The famed cathedral dominates the city, but there is much of antiquarian interest to be found elsewhere. The early 15th century parish Church of St. John the Baptist is Perpendicular; the guildhall is a splendid example of the arcaded Renaissance style; and there are a market house, 1671, and a charity school established by Henry VIII. Because it is a large railway junction, Peterborough to-day is thoroughly industrialized, and has railway works, agricultural, brick and tile manufactures, and a thriving trade in agricultural produce. Pop. 1921, 39,551; 1931, 43,558.

PETERBOROUGH, a city and the capital of Peterborough Co., and a port of entry, Ontario, Canada, lying on the Otonabee River, 70 mi. northeast of Toronto. The river, which at this point drops 50 ft. in several miles, provides abundant power for

numerous mills, including farm implement, hydraulic machinery, hardware, paper and textile factories. Products of local industries and of the surrounding, fertile agricultural district, are exported over adequate railroad connections to Georgian Bay, Trent Canal System and Lake Ontario ports. Situated in a picturesque countryside, Peterborough is pleasantly planned, having many parks, public works, schools and churches. Peterborough is the seat of a teachers' normal school, a collegiate institute and a conservatory of music. Named after its founder, Peter Robinson, it was incorporated as a city in 1905. Pop. 1921, 20,994; 1931, 22,327.

PETERBOROUGH, a town in Hillsborough Co., southern New Hampshire. It is situated on the Contoocook and Nubanusit rivers, 32 mi. northwest of Nashua and is served by bus lines and the Boston and Maine railroad. Peterborough has cotton and woolen mills and a basket factory. It is the seat of the MacDowell Colony for art and music students, Sargent Summer School and the Schofield Nursery. The town was founded in 1738 and incorporated in 1760. Pop. 1920, 2,615; 1930, 2,521.

PETERBOROUGH CATHEDRAL, Peterborough, England, one of the most important Norman churches in England. Begun about 1117, its choir was consecrated in 1140, and most of the cathedral was completed before 1200. The nave was erected in 1177-93; the great transept, 202 ft. in length, was built in 1155-77. A small western transept in the transitional style was added between 1193 and 1200. To these Norman portions, which rank high both



WEST FRONT OF CATHEDRAL, PETERBOROUGH, ENGLAND

artistically and structurally, the west front and the extreme east end present marked architectural contrasts. The façade, probably built in 1214 and 1222, with three high and deeply recessed arches, is a Gothic work of pronounced originality. The Perpendicular retrochoir with its ornate fan vaulting was added to the completed east end between 1438 and 1528. The original Norman windows were replaced in the Gothic period, but in 1643 Puritan troops destroyed the stained glass and a great part of the cathedral's decoration.

In 1587 the body of Mary Queen of Scots, now buried in Westminster Abbey, was brought to Peterborough Cathedral for interment; the Puritans destroyed her monument, but her first burial place is marked by a tablet. Catherine of Aragon, first queen of Henry VIII, was buried here in 1536 and it is said that in 1541 the monarch ordered the cathedral to be preserved as her mausoleum.

PETER IBBETSON, the first and undoubtedly the finest of the three novels by GEORGE DU MAURIER. Published 1891, it is the story of a man who lives almost entirely in a dream of the past. Peter Ibbetson, in his childhood in France, has loved Mimsey Seraskier. When later he loves Mary, Duchess of Towers, he discovers that she is Mimsey grown older and that he shares with her a strange, mutual dream. For murdering a maligning uncle he is imprisoned and spends 25 years of his sentence in his weird dream of the past. When the Duchess dies he loses his supernatural gift. Peter goes mad, but he is restored sufficiently by a visit from the Duchess, after her death, to write his fantastic autobiography.

Peter Ibbetson is also an opera in three acts by the American composer, DEEMS TAYLOR, based on the Constance Collier adaptation of the novel. The opera was first performed Feb. 7, 1931, at the Metropolitan Opera, New York City, with Edward Johnson as Peter Ibbetson and Lucrezia Bori as Mary. The libretto is in English and French. The opera was the second by the composer, and its première performance was generally praised by critics, although Taylor's debt to Wagner and Debussy was the subject of considerable discussion. The work was elaborately staged, with settings by Joseph Urban.

PETERKIN, MRS. JULIA MOOD (1880-), American author, was born in Laurens Co., S.C., Oct. 31, 1880, and educated at Converse College, Spartanburg, S.C. In 1903 she married William George Peterkin, a cotton planter, and went to live on a plantation. Her writings are vivid portrayals of Negro life in the South and include *Green Thursday*, 1924, *Black April*, 1927, and *Scarlet Sister Mary*, Pulitzer Prize novel in 1928. In 1932 Mrs. Peterkin published *Bright Skin*.

PETER MARTYR. See ANGHIERA, PIETRO MARTIRE D'.

PETER PAN, the chief character of a children's comedy of that name by JAMES M. BARRIE, produced in 1904. Peter, "the boy who would never grow up," is a blithe, aerial spirit who lives in the romantic Never-Never Land. One night he flies in through the window of the common-sense, everyday Darling home and entices away the three Darling children, John, Wendy and Michael. As in a dream, the children go with Peter through marvelous adventures, chiefly among Indians and pirates, but at last are brought home to their prosaic beds and the guardianship of Nana, their dog. *Peter Pan* was first produced in America in 1905 with MAUDE ADAMS in the title rôle.

PETER PARLEY. See GOODRICH, SAMUEL GRISWOLD.

PETERSBURG, an incorporated town in southeastern Alaska, in the first judicial division, situated on Mitko Island, in the Alexander Archipelago; served by steamships. The town has cold storage and fish packing plants, salmon canneries, commercial fisheries and a union oil tank station. Gold, silver, lead and copper are mined in the adjacent region. There is timber and some cultivated land. The traffic of the harbor for 1929 amounted to 22,079 tons worth \$5,095,966. Pop. 1920, 879; 1930, 1,252.

PETERSBURG, an inland port and independent city in Dinwiddie Co., southeastern Virginia. It is situated on the Appomattox River, 22 mi. south of Richmond. Bus and truck lines, steamships and three railroads serve the city. Petersburg ships cotton, lumber, tobacco and peanuts. The traffic of the river from this city to its mouth amounted to 25,250 tons in 1929. The chief manufactures are trunks, cigarettes, cigars and eyeglasses. In 1929 the value of the factory output was about \$17,000,000; the retail trade amounted to \$14,355,800. The headquarters of Cornwallis, Lafayette, Lee and Grant, old Blandford Church (1735) and cemetery, and the Confederate tunnels are interesting landmarks of Petersburg. Two national cemeteries are located in the vicinity. Petersburg, founded in 1733, was first incorporated in 1748. Pop. 1920, 31,012; 1930, 28,564.

PETERSBURG, SIEGE OF, June 15, 1864-Apr. 2, 1865, in the CIVIL WAR, an operation of Federal troops commanded by Gen. Grant. Changing his plan of campaign after the disastrous BATTLE OF COLD HARBOR, Grant crossed the James River with his army, and laid siege to the city of Petersburg. In late July Gen. Burnside completed an immense mine before the city, under the center of the Confederate fortifications. It was properly exploded; but Burnside was incompetent to take advantage of the Confederate panic, and the result was a loss to the Union of about 3,500 men in a few minutes. The siege continued throughout the winter, Lee's position becoming hopeless. Lee and President Davis agreed that Petersburg and Richmond must be relinquished when weather and roads permitted; but the Confederate army had not attempted to leave Petersburg when, at the news of Gen. Sheridan's victory at the BATTLE OF FIVE FORKS, Grant ordered a strong onset. Generals Parke, Wright, Humphreys and Ord distinguished themselves in the action of Apr. 2. Lee staved off final defeat by withdrawing during the night.

PETERSON, SIR WILLIAM (1856-1921), Canadian educator, was born at Edinburgh, Scotland, May 29, 1856. He studied at the universities of Edinburgh, Göttingen and Oxford, and in 1879 returned to Edinburgh as assistant professor of humanity. From 1882-95 he was principal of University College, Dundee, and in 1895 became principal of McGill University, a post he held for 24 years. Peterson published *Quintilian's Institutes of Oratory*, 1891; *The Dialogues of Tacitus*, 1893; *The Cluni MS. of Cicero*, 1901; and *Canadian Essays and Addresses*, 1915. He died at London, Jan. 4, 1921.

PETER THE GREAT (1672-1725), son of Tsar Alexei Mikhailovich (1645-76) and his second wife, Natalya Naryshkina, born at Moscow May 30, 1672. Grandson of the founder of the Romanov dynasty, Peter was the first Russian prince in whose veins flowed western European blood, his maternal grandmother was a Hamilton of Scotch origin, and his mother had been, for her day, liberally educated in the household of her guardian, Artamon Matveyev, a prominent and cultured minister of Tsar Alexei.

Besides Peter, Alexei had left two sons and several daughters by his first wife, a member of the Miloslavski family. Of the sons, Feodor, the legitimate heir, was 14 years old at his father's death; and Sophia, the only daughter to play an historical rôle, was 16. Upon Feodor's succession, a feud between the families of the late Tsar's consorts led to the disgrace and exile of Matveyev and to the relegation of Peter's mother and her four-year-old son to the village of Preobrazhenskoye, near Moscow. Tsar Feodor's health had always been precarious, and he died intestate in 1682. Since his older brother, Ivan, was a crippled and myopic moron, the leading officials and ecclesiastics deliberately passed him over in favor of Peter, from whose youth they expected a long and profitable regency.

They reckoned without Peter's half-sister, Sophia. Supported by her energetic favorite, Vasilii Galitzin, she secured the backing of the disaffected and rebellious Streltzy and the Moscow garrison troops, with the result that the entire Naryshkin party was wiped out. Ivan and Peter were proclaimed joint emperors with Sophia as regent during their minority. The disorders and perils of 1682 left an ineradicable impression on the mind of the ten-year-old Peter. At one moment, the mutinous Streltzy had become so menacing that even Sophia and her half-brothers took refuge in imperial country houses near the capital. When the danger was past, Sophia and Ivan returned to the Kremlin, but Peter and his mother remained at Preobrazhenskoye.

In contrast with the terrors to which his earlier childhood had been exposed and which left life-long sequelae in Peter's excessive nervousness, shyness and characteristic outbursts of ungovernable temper, the ensuing seven years of relatively peaceful existence at a safe distance from the capital were of major importance to his mental development. Instead of being confined within the narrow bounds of palace etiquette, Peter thus matured in a reasonably free atmosphere, surrounded by a heterogeneous group of companions. He formed intimate acquaintances with foreign officers and artisans residing in the so-called German suburb of Moscow, and developed a taste for shipping, for military exercises and, unfortunately, for excessive drinking which lasted during his entire life. Peter lacked theoretical education, but abundant practical training and an active and receptive mind replaced this deficiency to some extent.

In 1689, perplexed and shocked by the rough and ready manners acquired by Peter from his nondescript

associates, his mother thought to calm him by marriage with Eudoxia Lopukhina, a young and fairly intelligent noblewoman. Meanwhile, however, the Princess Sophia's power had declined with the approach of Peter's majority. Two fruitless and expensive Crimean campaigns sapped her popularity. An unsuccessful intrigue for the imperial throne then led, in 1689, to an open break with Peter and his mother. Fearing for his life, Peter fled in panic to the Troitse-Sergieva monastery, only to be speedily reassured by evidence that his partisans were unexpectedly numerous. After the army went over to Peter, Sophia was powerless, and she abandoned the field to her successful rival.

In the course of the next five years, Peter left the administration largely in his mother's hands, devoting himself to the development of an army and navy with the aid of foreign advisers. Upon his mother's death in 1694, he proceeded to attack and reduce the Turkish fortress of Azov at the mouth of the Don. Animated by an intense desire both to see foreign countries and to unite all Christendom in a league against the Turks, Peter, in 1697, launched a huge embassy to western Europe which he himself accompanied under an assumed name and with the rank of a simple army sergeant. Though the political purposes of the mission were unrealized, the resultant contact with European civilization definitely established Peter in his self-chosen rôle of reformer and innovator.

Upon his return to Moscow in 1698, his first acts of domestic policy were the sequestration of his wife, Eudoxia, in a convent and the savage repression of the last rebellion of the Streltzy. The ensuing 20 years were devoted almost entirely to a war with Sweden, which terminated the rôle of that nation as a world power and gave to Russia the status of a first-rate European power, which it has held for the last two centuries.

In 1703, Peter proclaimed his final break with Muscovite tradition by the foundation of St. Petersburg (Leningrad) at the mouth of the Neva. In 1712, he married Catherine Skovronskaia, a woman of humble origin but considerable native wit whose influence upon her husband's volatile temperament was in the main salutary; she was not crowned Tsarina till 1724. The Empress Elizabeth (1741-61) was one of the daughters of this union. Alexei, Peter's only son by Eudoxia (born 1690), became involved with his father's enemies and died in prison (1718) as a result of the torture to which he had been subjected even in his father's presence. Peter's own health began to fail shortly after; his youthful excesses and constant ruthless expenditure of physical energy now exacted their toll, and he succumbed to a complication of diseases on Jan. 28, 1725.

S. H. C.

BIBLIOGRAPHY.—K. Waliszewski, *Peter the Great*, 1897; S. Graham, *Peter the Great*, 1929; G. Oudard, *Peter the Great*, 1929.

PETER THE HERMIT (c. 1050-1115), French monk and preacher, also called Peter of Amiens, the

city where he was born about 1050. Early in his life as a hermit he is reputed to have made a pilgrimage to Jerusalem, and on his return to have spread the report of the desecration of the Holy Sepulcher by the Seljuk Turks, who had taken Jerusalem in 1070, elaborating his reports with many stories of brutalities and injustices inflicted by the infidels. Pope Urban II is said to have commissioned him as one of the preachers of the Crusade the Pontiff organized in 1095 against the Turks, and Peter set forth, barefoot, riding on an ass and carrying a huge cross. His travels took him into the towns of France, and into Germany, where with Walter the Penniless he harangued the crowds in the market places and the churches. The indignation thus aroused caused a preliminary band of Crusaders and outlaws, 100,000 strong, to set out for the East, by way of Constantinople. Under the temporary leadership of Walter, while Peter sought aid in Constantinople, they encountered the Turks near Nicaea in Asia Minor, in 1096, and were massacred in large numbers. Peter then joined the First Crusade under GODFREY DE BOUILLON, who captured Jerusalem in 1099. Peter the Hermit died at Liège, Belgium, July 11, 1115.

PETIT JEAN PARK, a state park near Morrilton, in central Arkansas, 70 mi. northwest of Little Rock. An 80-acre tract was set aside in 1923 to preserve Petit Jean Mountain from lumbering interests and by 1926 was enlarged to an area of 1,128 acres. A road and trails lead to the places of particular scenic interest, the Seven Hollow region, the picturesque gorge 2 mi. long and 200 to 400 ft. deep, the interesting caves, rock formations and canyons.

PETITION, a term setting forth a grievance and praying that the same be remedied. In most cases the petition must be in writing, must not contain disrespectful language and must, in form, petition or ask those in power to do justice. On the other hand, persons signing a petition are not subject to punishment for the presentation of the same.

PETITION OF RIGHT (1628), a declaration by Parliament that no freeman be required to give any gift, loan, benevolence or tax, except according to Act of Parliament; that no freeman be imprisoned or detained contrary to law; that soldiers and mariners be not billeted in private houses; and that commissions to punish soldiers and sailors by martial law be revoked, and no more issued. See MAGNA CARTA.

PETÖFI, SANDOR (1823-49), Hungarian poet, was born at Kiskörös, near Pest, Jan. 1, 1823. After leading a miserable existence as a strolling player, he finally settled at Pest in 1844, when his first book of verse was published. Following in rapid succession were a number of volumes of poems that received a definitive collection in 1847. Young as he was, Petöfi was established as the chief of Hungarian lyric poets, for the simplicity, genuineness and passionate fervor of his verse exercised a universal appeal. The poet threw himself into the revolutionary movement of 1848 and died on the battlefield of Segesvár, July 31, 1849.

PETOSKEY, a port city in northern Michigan, the county seat of Emmet Co., situated on Little Traverse Bay, an inlet of Lake Michigan, about 200 mi. north of Grand Rapids. Airplanes, bus and truck lines, lake steamers and two railroads afford transportation. Petoskey, surrounded by beautiful country, is popular as a summer and winter resort. The chief crops of the vicinity are potatoes and fruit. The leading manufactures are cement and wood products. Near by are mineral springs, the Indian council grounds and Magnus State Park. Petoskey was incorporated in 1890. Pop. 1920, 5,064; 1930, 5,740.

PETRARCH, FRANCESCO (1304-74), Italian poet and humanist, called in Italian Francesco Petrarca, was born at Arezzo, July 20, 1304. He received his early schooling at Pisa and at Avignon, then the residence of the Pope. He studied law at Montpellier and later, 1319-26, at Bologna. His heart, however, was not with the law but with his beloved classics, and he would often at this period deprive himself of necessities to purchase costly manuscripts. But it was only after the death of his father in 1326 and upon his return to Avignon that he was able to indulge freely in his classical pursuits.

It was at this time, 1327, that he met and fell in love with the woman who was to hold the key to his emotional and artistic life for many years to come, the woman celebrated in his sonnets as Laura. She was apparently a married woman of his acquaintance who later became the mother of eleven children and died in 1348. Petrarch consoled himself by a stream of world-famed sonnets, by immersing himself in his classical studies, and by building up his library of classical manuscripts.

Meanwhile he had written the epic poem, *Africa*, in Latin verse, winning such admiration that he was crowned Laureate by the University of Paris and by the Roman Senate in 1341. The other Latin works of Petrarch would fill a large volume of 1,200 pages. Of some interest to modern readers in this collection is the *Secretum Petrarcae*, a series of imaginary dialogues with St. Augustine modeled on the latter's *Confessions*. His *Letters* are important since Petrarch corresponded with almost every influential figure of his age. There are some 300 of these letters throwing considerable light on the culture of the 14th century, including the alleged moral decadence of the Papal court at Avignon.

Petrarch is known to us to-day essentially for the 300 sonnets he has embroidered around the name of Laura and the theme of love. But he calls these sonnets *nugae* or trifles, and possibly the true significance of the poet's life is to be found in his prodigious efforts to popularize the study of the classics, thus imparting to European civilization that humanistic trend still apparent to-day. Petrarch died at Arquà, July 20, 1374, his 70th birthday.

BIBLIOGRAPHY.—F. de Sanctis, *Saggio critico sul Petrarca*, new ed. 1907; K. McKenzie, *Concordanza delle rime di Francesco Petrarca*, 1913; *Epistolae Selectae*, ed. by A. F. Johnson, 1923; E. H. Tatham, *Francesco Petrarca*, 1925-26.

PETREL, the common name for a numerous family (*Hydrobatidae*) of small ocean birds allied to the albatrosses. There are over 100 species, widely distributed in all the seas of the world, but most abundant in the Southern Hemisphere. They are remarkable for their great powers of flight, following vessels at sea for days at a time, apparently without rest, and venturing to land only when driven by storms or to nest. Petrels are distinguished by their tubular external nostrils, long narrow wings, webbed feet and sooty black or gray plumage, which is often marked with white. They nest in holes among rocks, in burrows in the ground or in clumps of grass, laying a single white or whitish egg. The name petrel is derived from the Latin *petrellus*, meaning "little Peter," for these birds appear to walk, as the Apostle Peter is said to have done, on the surface of the water.

Among the best known species is the stormy petrel (*Hydrobates pelagicus*), common in the Atlantic Ocean. This small bird, no larger than an English sparrow, was formerly an object of superstition to sailors, who called it Mother Carey's chicken and believed it to presage disaster. Other common species are Wilson's petrel (*Oceanites oceanicus*), a similar but somewhat larger bird, likewise abundant in the Atlantic, and Leach's petrel (*Oceanodroma leucorhoa*), called also fork-tailed petrel, of both the north Atlantic and north Pacific. See also FULMAR; SHEARWATER.

PETRIE, SIR WILLIAM MATTHEW FLINDERS (1853-), English Egyptologist, was born at Carlton, England, June 3, 1853. He became interested in archaeological research when quite young and in 1880 published a book on Stonehenge. Explorations at the pyramids of Giza were his first Egyptian work. He discovered the long-lost Greek city of Naukratis in 1885, the towns of Am and Daphne in 1886 and in 1891 the ancient temple at Medum.

Following the publication of his *Ten Years' Diggings in Egypt*, in 1893, he occupied the chair of Egyptology at University College, London. The following year he established the Egyptian Research Account, since 1905 the British School of Archaeology in Egypt, which has accomplished an important investigation of the site of Memphis. Petrie was knighted in 1923.

PETRIFICATION, the preservation of organic remains by the infiltration of mineral matter. Such mineral substances may constitute an interstitial addition, or actually replace the organic matter, molecule for molecule. In this manner the original structure is often beautifully preserved, as in wood petrified with silica. Other minerals frequently occurring in petrifications are pyrite, limonite, malachite, sulphur and calcite. See also FOSSIL.

PETRIFIED FOREST NATIONAL MONUMENT, a region in Arizona, literally a series of petrified forests situated a short distance south of Adamana on the Santa Fé railroad. Established by the U.S. Government in 1906, it now contains 40 sq. mi. and comprises the First, Second, and Third Forests.

The trees of the Petrified Forest belong to *Aratocarioxylon arizonicum*, a coniferous species related to the pine, now extinct. They grew in the Triassic period, in the age of reptiles, or approximately 200,000,000 years ago, in a region near their present location. After falling, they travelled down a watercourse and lodged in an eddy or sand bank where eventually they became buried beneath several thousand feet of sand and clay. The petrification which took place during the ages when these trees were buried gradually replaced the woody materials with silica in the form of chalcedony. Iron oxides gave the brilliant reds, yellows and browns. The clay and sand were afterwards washed away, a process which is still going on. The trees are now lying prostrate; some measure as much as 6 ft. in diameter and over 100 ft. in length, indicating that with branches and foliage they must originally have exceeded 200 ft. in height. About ½ mi. east of the First Forest is the Natural Bridge, a 110 ft. log bridging an arroyo which has been eroded from beneath it. The Second Forest contains a number of logs of a yellowish gray color. Under the microscope, sections of these logs show minute details of the original wood. The Third or Rainbow Forest is the largest of the forests and surpasses the other two in number of logs and brilliancy of coloring. In the western portion of this deposit, the ground is literally covered with chips of carnelian, onyx, agate and jasper.

PETRIFIED FORESTS, fossil tree-stumps and logs occur in sufficient quantities to justify the name, petrified forest, in many parts of the world. Notable examples are found near Cairo, Egypt, in Arizona, at Gilboa, N.Y., and Flora, Miss., near Calistoga Hot Springs, Cal., and in Yellowstone National Park.

In most instances the trees of these ancient forests were thrown down, possibly by earthquake, before being buried and fossilized, or else have been transported some distance from the place where they originally grew. Peculiar interest attaches therefore to petrified forests of standing trees with their roots in bedrock. Of these the oldest known is the recently discovered forest of later Devonian seed ferns in the Catskills, unearthed during excavations for the Gilboa (or Schoharie) Reservoir. Here tree localities were found scattered over a mile and two-thirds. Since the filling of the reservoir, these Gilboa trunks must be sought mainly in the state museum at Albany. In the Yellowstone, however, extensive Tertiary forests of sequoias, are found *in situ*, their weathered and broken trunks, shorn of foliage branches, projecting sometimes 20 to 40 ft. above the ground. One of the largest measures 26½ ft. in circumference, indicating a living height of 100 ft. In the slope of Amethyst Mountain within the park is exposed a petrified forest 15 or 20 stories high, trees of successive ages appearing superimposed throughout 2,000 ft. of strata.

PETROGLYPHS, designs or pictures carved on the surface of a rock. Ancient petroglyphs were in the same style as the pictures carved on bone or ivory

with a sharp pointed flint. Many of the Palaeolithic pictures in the caves of Spain and France were first sketched in outline with a flint graver. Some of the finest petroglyphs are found in Norway, as at Bola on lake Snaasen-vend, where a reindeer was engraved in outline on a rock beside a waterfall. In Norway and Sweden there are rock pictures of ships belonging to the BRONZE AGE. Another style was the drawing of figures of animals by a series of hammered dots, as in the case of the two-horned rhinoceros on the wall of the Grotte du Trilobite near Arcy-sur-Cure, France. It is worth noting that a similar style of depicting animals by dots is found among the Bushmen of South Africa. There is, in fact, a two-horned rhinoceros at Wolmaransstad closely resembling the picture of the same animal in the Grotte du Trilobite. See ARCHAEOLOGY.

PETROGRAD. See LENINGRAD.

PETROGRAPHY, the geological science concerned with the systematic study and description of rocks. It is a branch of PETROLOGY, the study of the origins, relationships, alterations and decay of all the various types of rocks. Petrography concerns itself with the investigation of the mineral and chemical constitution of rocks, as revealed to the eye in hand specimens, under the MICROSCOPE in thin sections, and by chemical analysis. For the microscopic work, a chip of the rock is ground down with an abrasive on iron and glass discs, until it is about 0.03 mm. thick. Even the darkest rocks are then transparent. The petrographical microscope is employed to determine the minerals in the specimen, making use of the optical properties shown by minerals in such thin sections, as mentioned under "MINERALOGY." This technique has been most prolific of valuable information as to the origin and subsequent alteration of rocks. See also CRYSTALLOGRAPHY; GEOLOGY.

PETROLATUM, LIQUID: As a laxative. See CATHARTICS.

PETROLEUM, called also mineral oil, rock oil and crude oil, a dark, oily, inflammable liquid produced by natural processes and accumulated within certain rock formations beneath the earth's surface. It is usually associated with NATURAL GAS. In recent years the demand for the products obtained by refining crude oil, such as gasoline, kerosene, fuel oils, lubricating oils, waxes and asphalts has increased so spectacularly that petroleum now ranks second only to COAL as the source of the world's energy. The variety of these derivatives is an indication of the complexity of the parent substance, which consists of a mixture of various hydrocarbons, compounds of hydrogen and carbon. Two series of these substances are especially important, the PARAFFIN series in the so-called paraffin base petroleum, and the NAPHTHENE series in the naphtha base oils. A given productive area is often characterized by one or the other type, as the Appalachian and older Kansas and Oklahoma formations by paraffin base oils, and California and Texas by naphthene base petroleum. The remaining hydrocarbons are usually of a less stable,

unsaturated type, by which is meant they do not contain the maximum possible amount of hydrogen. They are less desirable than the others, and are often more prominent in the naphthene base oils. Their tendency to form ASPHALT, when exposed to the air or chemical agents, is responsible for the name asphalt base often being applied to the naphthene base oils. The majority of the hydrocarbons in petroleum are liquids, but solids and gases occur dissolved in them. Some oils, especially of the heavier types, contain sulphur, oxygen and nitrogen compounds. The specific gravity of crude oil varies from .7368 to nearly 1, or in the Baume scale commonly used to express the weight of petroleum, from 60 deg Baume to 10 deg. Baume.

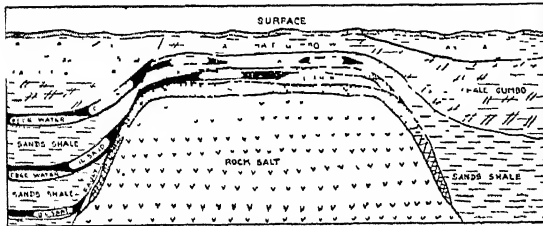
Origin. The source of the hydrocarbons composing petroleum was formerly in dispute. Some authorities believed they resulted from the action of water on carbon compounds, especially iron carbide, in the hot interior of the earth, whence they rose gradually nearer the surface through pores and cracks in the overlying rocks. Most geologists and chemists now hold, however, that petroleum is the product of the partial decay of organic matter. In this it is closely related to coal.

Although such marine animals as fish, molluscs, crustaceans and foraminifera may have been important in the formation of some oil deposits, it is probable that the largest rôle has been played by marine plants. Diatoms, algae, seaweeds, fragments of higher forms, with spores, seeds and pollen of land plants accumulated in near-shore deposits of shallow or moderate depth, would be intimately mixed with and imprisoned in fine silt from the land. The oxygen in the organic matter would be largely removed through the attack of anaerobic bacteria. Thus, hydrogen and carbon compounds would predominate in the residues of this partial decay. The decomposition would finally be halted through the complete covering of the material by later deposits. Although the process is one which can go on in fresh or sea water, marine deposits are thought to have been the source of most mineral oils.

Petroleum may be produced directly in this manner, but many observers believe that an intermediate substance, KEROGEN, is the direct product. It consists of globules and laminae of yellow to black carbonaceous matter found in so-called OIL SHALES. Since petroleum-like oil can be produced from kerogen shales by heat or pressure, it is thought such shales represent the earliest silts impregnated with partially decayed organic remains. When they are subjected to considerable squeezing or heating, or both, during movements of the rocks of the earth's crust, a progressive distillation takes place which produces gaseous and liquid hydrocarbons, and carbonized residues.

Accumulation. Clay or shale containing oil and gas formed by either process mentioned will retain them in the fine pore spaces unless they are forced out by pressure, or the superior capillary attraction of water. When thus forced out, the petroleum and gas

will naturally circulate through the most porous formation available, such as a sandstone, fissile shale, or cavernous limestone. Because both substances are lighter than water, and water is found in most buried rock strata, they will migrate toward the surface. Unless trapped behind an impervious barrier, they will reach the surface and be lost. SHALE beds,



COURTESY DEPARTMENT OF CONSERVATION LOUISIANA

TYPICAL SALT DOME SECTION

Oil and gas are frequently trapped where porous strata abut against the impervious plug of salt

igneous DIKES, salt domes and FAULTS in which there occurs a gouge, or clayey material, serve as excellent barriers. The most favorable situation for the accumulation of oil and gas is where some structural irregularity, such as an ANTICLINE, or arch, in porous rocks, is capped by impervious beds. Gas will gather in the pores of the highest parts of the "reservoir" rock, while next below it, as on the flanks of an anticline, will be found the oil. Lower still occurs the salt water usually associated with petroleum. Porous SANDSTONES and cavernous LIMESTONES involved in some such structure as that described, and not far distant from kerogen shales, have been observed to present favorable conditions for the occurrence of oil deposits, or oil pools.

Oil-producing beds may be from 2 or 3 feet to 200 feet thick, and their porosity varies from 5% to 50%. A sandstone, or sand as it is called by oil men, with an average porosity of 20% will hold 1550 barrels of oil per acre for every foot of its thickness, but will yield only about 20% of this under present extraction methods.

Exploitation and Distribution. Oil pools are exploited by DRILLING a hole a few inches in diameter through the overlying formations, puncturing the impervious cap and penetrating the reservoir rock. The oil often seeps into this hole or well, and is pumped out, but not infrequently the pressure of the entrapped gas produces an almost explosive rush of the petroleum, resulting in a "gusher." Commercial production is obtained from deposits as deep as almost two miles below the surface, as in California. Oil beds are mined, as in Pechelbronn, France, but this is rare.

Formerly oil pools were located largely by "wild-cattling," or drilling almost at random. Nowadays, however, careful geological examinations are made before going to the expense of drilling. Surface seeps of oil are looked for, the occurrence of kerogen shales investigated, and geological structures carefully mapped to determine whether or not a given region is favorable for the origin and accumulation of crude oil.

In the study of geological structures, the new science of GEOPHYSICS has proven of great aid.

The great oil producing formations of the world are of PALEOZOIC, CRETACEOUS and TERTIARY ages, they having produced, respectively, 41%, 15% and 44% of the world's total. Within the United States the Paleozoic rocks are productive in the Middle West and East, or Mid-Continent and Appalachian fields, Cretaceous ones in the Rocky Mountain and Gulf Coast regions, and Tertiary in the Gulf Coast and California. Elsewhere than in North America, development is almost entirely in Tertiary rocks.

Although petroleum was used in lamps in the times of Herodotus and Pliny, commercial production did not properly begin until 1859, when Col. Drake found oil in western Pennsylvania at a depth of 69 feet. It was employed as a medicine at first, and when distillation was applied to separate the various constituents, kerosene served as a substitute for whale oil in lamps. Natural gas was also used as an illuminant. The development of the internal combustion engine brought about the present ever-increasing demand for gasoline and fuel oil, distilled from crude oil. The hundred million barrel mark in the production of petroleum was reached in 1895, and the half billion mark in 1917. Six years later this figure was doubled. In 1930 the world production of crude oil was one billion four hundred million barrels, of which the United States produced about 64%, or 896 million barrels. The United States seems likely to retain its preeminent position for a considerable time although future increases in production may be expected from South America, and along the borders of the Caspian and Black Seas, in Persia and Mesopotamia.

With improved methods of DISTILLING, the useful products derived from petroleum have increased enormously, so they now number hundreds of gaseous, liquid and solid compounds. *See also CANNEL COAL; GEOLOGY.* S. F. K.

BIBLIOGRAPHY—Ernest R. Lilley, *The Oil Industry*, 1925; Ernest R. Lilley, *Geology of Petroleum and Natural Gas*, 1928; W. T. Thom, *Petroleum and Coal, the Keys to the Future*, 1929; C. K. Leith, *World Minerals and World Politics*, 1931.

World Production. The world's production of crude petroleum in 1930 approximated 1,419 million barrels, of which 63.4% was contributed by the United States; 9.7% by Venezuela; 9.6% by Russia; 3.2% by Persia; 2.9% by Roumania; 2.8% by the Dutch East Indies; 2.8% by Mexico; 1.4% by Colombia; and the remaining 4.2% by some 18 other countries.

Of the 898 million barrels of crude petroleum produced in 1930 in the United States 32% was derived from Texas; 26% from California; and 24% from Oklahoma; while the remaining 18% was divided among 16 additional states, particularly Louisiana, Arkansas, Wyoming, Pennsylvania, and New Mexico.

The commercial production of crude petroleum dates from the drilling of the Drake well in Pennsylvania in 1859, but it was not until 1895 that the world's production reached 100 million barrels and not until 1903 that the output of the United States

attained that figure. The life of the petroleum industry is, therefore, but a brief 70 years and the rate of growth of petroleum production during this period has been very rapid, as shown in the following tabulation:

CRUDE OIL PRODUCTION, BY DECADES, 1860-1930

(In millions of barrels)

YEAR	UNITED STATES	OTHER COUNTRIES	WORLD
1860	0.5	..	0.5
1870	5.3	0.5	5.8
1880	26.3	3.7	30.0
1890	45.8	30.8	76.6
1900	63.6	85.5	149.1
1910	209.6	118.2	327.8
1920	442.9	246.0	688.9
1930	898.0	521.0 ^a	1419.0

The economics of oil production has unfortunately lagged behind the technological improvements, with the result that the producing industry has been beset with the problems of overproduction. Owing to the prevalence of subdivided land ownership in oil fields, particularly in the United States, and the migratory character of the oil, excessive drilling is stimulated within the single unit or pool and the productive effort has gone forward faster than needed. An excessive potential supply of oil has been drilled and in 1928 the producing industry began a series of attempts to control the output by a system of prorating the output in the various districts and fields. The cooperative effort at stabilization is creating new economic problems and is still in its experimental stage. Engineers and economists favor a unitization of operations within the single pool, in order to avoid wastes incidental to competitive drilling and to gain the advantages of lower costs and more efficient extraction. This efficient and economic mode of production has already made some headway in the United States, and is prevalent abroad. It is probable that in the United States far-reaching changes will be ultimately brought about in the economic procedure in oil production. J. E. P.

PETROLEUM REFINING, a process and an important industrial activity by which the constituent usable compounds of crude oil are separated and purified. **PETROLEUM** is a mixture of chemical compounds containing hydrogen and carbon, called **HYDROCARBONS**, with variable but usually smaller percentages of compounds containing sulphur, oxygen or nitrogen combined with these elements. Water, uncombined sulphur, hydrogen sulphide and earthy matter are frequently present. The hydrocarbons may be grouped in different series or families having distinctive physical and chemical properties. Compounds within each series vary also, thus some are gases, others liquids and others solids at normal temperatures and pressures. Many of the compounds are unstable, particularly at high temperatures, and tend to decompose to form other hydrocarbons and residual carbon or coke.

The work of the petroleum refinery is the separa-

tion of groups of compounds having similar characteristics from those having different properties, the removal of undesirable or obnoxious substances, the generation of new desirable compounds, and the blending or mixing of the materials available so as to produce marketable **GASOLINE**, **KEROSENE**, lubricating oils (*see* **LUBRICATION AND LUBRICANTS**), **FUEL OILS**, and less important liquid products. In addition, it produces the semi-solid and solid products; wax, petroleum jelly, **ASPHALT** and **COKE**. The more complete refineries may also produce such special products as insecticides, medicinal oils and jellies, and industrial alcohols.

PETROLEUM REFINING, U.S., 1929

State	No. Establishments	Employees and Wage Earners	Salaries and Wages	Value of Products
United States	390	94,393	\$164,754,867	\$2,639,665,001
LEADING STATES				
Texas	83	22,245	33,069,381	519,005,136
California . . .	54	10,172	20,946,936	484,756,207
New Jersey	10	9,208	17,923,586	297,151,470
Pennsylvania ..	48	9,495	16,608,214	243,258,869
Oklahoma . . .	48	6,338	10,999,650	183,681,931
Louisiana	13	7,866	13,895,097	151,966,142
Illinois . . .	12	4,808	8,143,593	104,130,272
Kansas	15	3,597	6,100,646	98,329,442

The basic process in refining is a combination of **DISTILLATION** and **CONDENSATION**, a process in which the different ingredients are separated from each other according to their boiling points. The separation of waxes and petroleum jellies from high-boiling-point liquids, such as lubricating oils, is not possible by this method but may be effected by the use of filter presses, **CENTRIFUGES**, cold-settling tanks and sweating pans. Here separation is due to differences in the solidification points of the various compounds present. Distillation in the presence of steam or under a vacuum retards decomposition and is used to preserve desirable qualities in oils. High temperatures and pressures bring about cracking (*see* **CRACKING PROCESS**), a process of decomposition in which low-priced heavy oils are converted into gasoline.

Sulphur and other undesirable substances are generally removed by treating with sulphuric acid and caustic soda. Treatment with liquid sulphur dioxide, plumbite solution, or hypochlorite solution, filtration through special clays, charcoal, or silica gel are other processes in common use. It is customary to blend gasolines from different sources to secure uniform grades. Similarly, two or more lubricating oils may be blended together or compounded with organic oils or soaps to obtain certain lubricating properties.

E. R. L.

PETROLOGY, the study of the rocks which everywhere underlie the earth's surface. A geologic science, it treats of the origin, present condition, changes and decay of rocks, and by tracing their com-

plete history adds greatly to the knowledge of how the earth came to its present state. The obsolescent term lithology has been applied to it, and petrography is incorrectly used as a synonym for petrology. PETROGRAPHY is really that branch of petrology which concerns itself with the description of rocks.

A rock is usually defined as an aggregate of one or more minerals which forms an essential part of the earth. A certain constancy of chemical and mineral composition is implied, so that the rock may have a sufficiently individual character to establish its identity. Thus, the chance filling of a fracture by a vein containing variable amounts of calcite, quartz, and ore minerals is not recognized as a rock.

The original source of rock forming minerals is within the ASTHENOSPHERE, the hidden, highly heated interior of the earth. There the component parts exist as elements, or oxides, or other compounds stable at the tremendous pressures and high temperatures believed to obtain beneath the surface. Local super-

heatings, or reliefs of pressure, produce local liquefactions, and the molten mass, or MAGMA, is squeezed towards the surface by the pressure of the surrounding material. It proceeds by melting a path through the overlying rocks, or pushing them out of the way when near the surface. Thus plutonic, or deep-seated bodies of igneous rock are produced, the component minerals solidifying as the magma cools.

The great mass of IGNEOUS ROCKS is believed to be basic, that is high in iron and magnesium, and the rocky envelope of the earth probably consists mostly of BASALT, PERIDOTITE, or even more basic forms. GEOPHYSICAL data based on observations of the average density of the earth and the speed of transmission of earthquake waves through it, support this belief. Rocks which have cooled well beneath the surface are often more basic than the shallower intrusives and extrusives, such as the GRANITES which predominate at the earth's surface. The production of these latter, the more acid rocks, is the result of differentiation in

IGNEOUS ROCKS

Modified after Kemp

	ACIDIC	EXCESS OF LIGHT-COLORED MINERALS			INTERMEDIATE		EXCESS OF DARK-COLORED MINERALS		BASIC		
OCCUR- RENCE	Principal Minerals	Chief Feldspar: Orthoclase			Chief Feldspar: Plagioclase				No Feldspar		
		Biotite (or) (and) Hornblende (or) (and) Augite			Biotite (or) (and) Hornblende		Pyroxenes (Pyroxene, Augite, etc.)		Augite (or) (and) Hornblende (or) (and) Biotite		
		+ Quartz	— Quartz	Nephelite or Leucite	+ Quartz	— Quartz	— Olivine	+ Olivine	— Olivine	+ Olivine	
	SiO ₂	80-65%	65-55%	60-50%	70-60%	65-50%	65-50%	55-45%	55-30%		
Laccoliths, Batholiths	Coarse texture	Granite	Syenite	Nephelite- Syenite	Quartz-Diorite	Diorite	Gabbro Group				
							Gabbro	Olivine- Gabbro	Pyroxenite	Peridotite	
Laccoliths, Sills, Dikes	Large crystals (phenocrysts) in finer ground-mass	Granite porphyry and Rhyolite porphyry	Syenite porphyry and Trachyte porphyry	Nephelite- Syenite porphyry and Phonolite porphyry	Quartz-Diorite porphyry and Dacite porphyry	Diorite porphyry and Andesite porphyry	Gabbro porphyry and Augite- Andesite porphyry	Olivine- Gabbro porphyry and Basalt porphyry	Pyroxenite porphyry and Augite porphyry	Peridotite porphyry and Limburgite porphyry	
Dikes and Surface Flows	Glassy, felsitic, or cellular	Rhyolite (Felsite)	Trachyte (Felsite)	Phonolite (rare), Leucite rocks (very rare) (Felsite)	Dacite (Felsite)	Andesite (Felsite)	Augite- Andesite	Basalt	Augite	Limburgite	
								Basalt Group			
Bed, Strata	Fragmental	Rhyolite tuffs and breccias	Trachyte tuffs and breccias	Phonolite tuffs and breccias	Dacite tuffs and breccias	Andesite tuffs and breccias	Basaltic tuffs and breccias				
Crusts and Surface Flows	Glassy	Acid Glasses, Obsidian, Perlite, Pitchstone				Andesite obsidian	Basic glasses, Basalt obsidian				
	Cellular	Pumice				Scorias					

the basic magma, the mechanism of which has been the object of physico-chemical investigation in geophysical laboratories. Under the control of laws of physical chemistry, the liquid magma may separate into two or more parts, by the separation of immiscible liquid portions, or by the gravitative settling of first crystallized material, or by the concentration of liquid and gaseous fluxes in upper portions of the mass. The melting and assimilation of rocks through which the magma passes will also affect the final composition of the cooled material. These processes produce intrusive rocks richer in silica, sodium, potassium, and lower in iron, calcium and magnesium than the deeper, plutonic forms.

The important component minerals of igneous rocks are limited in number, being silica, and silicates of aluminium, sodium, potassium, iron, calcium, and magnesium. In approximate order of abundance they are, FELDSPARS, QUARTZ, AUGITE, HORNBLÉNDE, OLIVINE, MICA, MAGNETITE, TITANITE, and ILMENITE. Combined in various proportions they compose the igneous rocks, divided into "clans" according to mineral composition, such as GRANITES, granodiorites, DIORITES, GABBROS, SYENITES, and peridotites-pyroxenites.

These rocks, subjected to processes of WEATHERING, are disintegrated into SOIL. Soluble minerals are dissolved and eventually transported to the ocean or land-locked basins, where they increase the salinity of the water. Organisms, extracting calcium carbonate from sea water for their shells, produce great accumulations

of calcite, forming LIMESTONE. In enclosed basins evaporation may produce chemical precipitates such as salt, as may be seen today in the Great Salt Lake. More resistant minerals, such as quartz, mica, and KAOLIN from feldspar disintegration, may be mechanically transported by running water to accumulate into beds of SANDSTONE and SHALE. Thus the SEDIMENTARY ROCKS are derived primarily from the igneous ones. The important minerals in them are, quartz, feldspars, MUSCOVITE, kaolin, DOLOMITE, CHLORITE, CALCITE, and LIMONITE.

Either igneous or sedimentary rocks may be transformed by metamorphic processes into GNEISS, SLATES, SCHISTS, PHYLLITES, and MARBLES, known as METAMORPHIC ROCKS. Heat, pressure, and hot solutions, acting as a result of deep burial, invasion by molten magmas, or mountain building crustal movements, act on the minerals, recrystallizing them, making new ones out of them, and introducing new material, to produce this third type of rock.

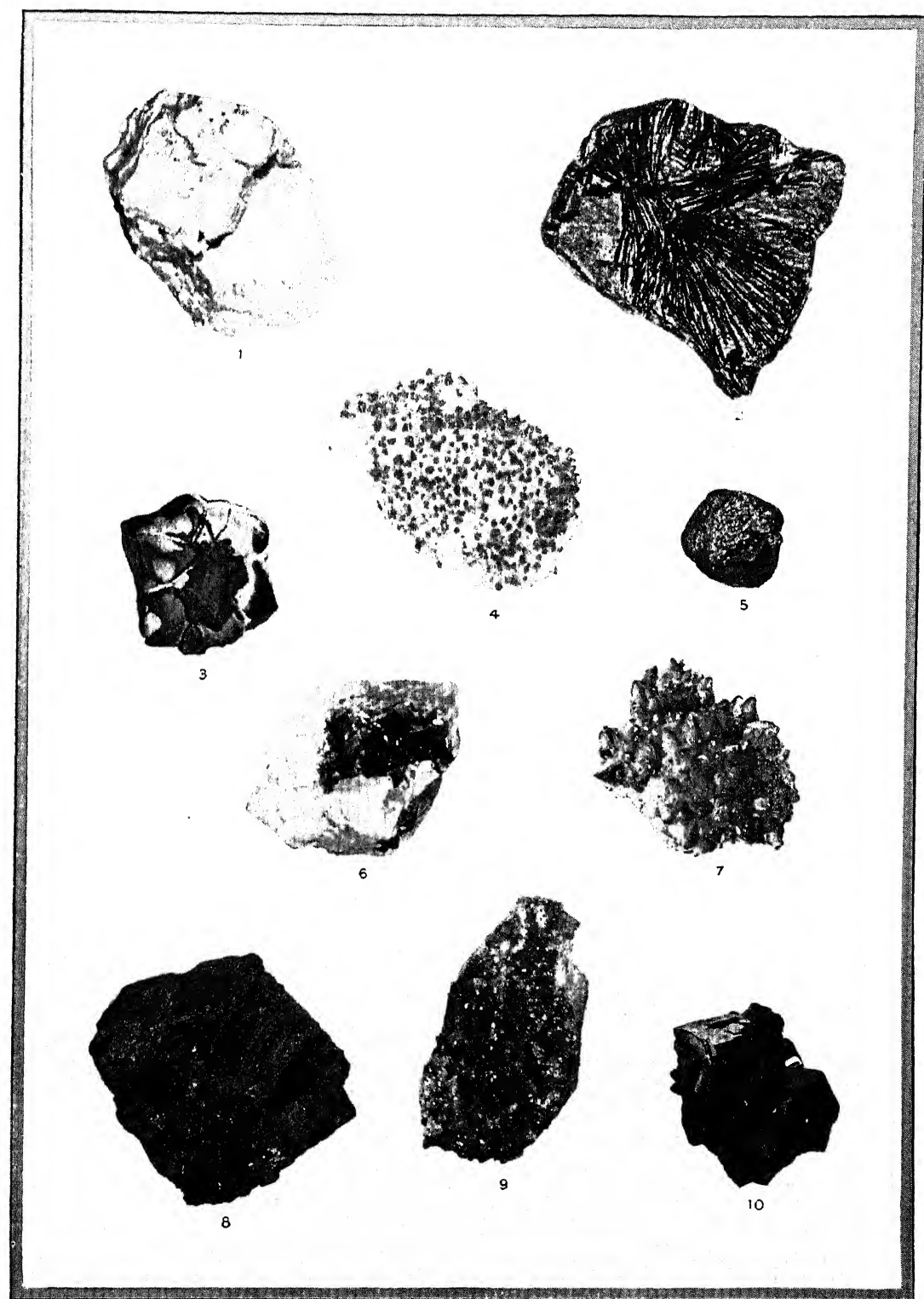
For the study of rocks, the petrographic, or polarizing microscope is invaluable. The optical properties of minerals, described in CRYSTALLOGRAPHY, are used to identify them and reveal their manner of crystallization. Chemical analyses shed great light on the chemical constitution of rocks, and are the basis of the more detailed classifications, especially of the igneous group. For the sedimentary group, the study of heavy residues and dolocasts has been found useful. Heavy residues are the particles of heavy accessory minerals left when the lighter parts of a pulverized

SEDIMENTARY ROCKS

After Kemp

TEXTURE	FRAGMENTALS NOT LIMESTONES		TRANSITION TO LIMESTONE	LIMESTONES		ORGANIC ROCKS NOT LIMESTONES	PRECIPITATES FROM SOLUTION
	Loose	Consolidated	(Consolidated)	Loose	Consolidated	Chemical Character	
Coarse	Gravel	Conglomerate	Calcareous conglomerate	Limestone-Rubble Gravel Coral heads, etc.	Rubble-Limestone	Alkaline	Rock salt—gypsum, stalactites, stalagmites, "Mexican onyx"—travertine
	Sands	Sandstone	Calcareous sandstone	Shell or coral sands	Sand limestones Coquina	Siliceous	Infusorial or diatomaceous earth Some cherts Some sinters
Fine to Medium		Argillaceous sandstone					
	Mud	Shale	Calcareous shale	Shell or coral muds	Mud limestones	Ferruginous	Some limonite Some limonite
	Silt	Clay	Marl	Calcareous slimes or ooze	Lithographic limestone	Carbonaceous	Peat Lignite Bituminous coal Anthracite Asphaltes

PETROLOGY



COURTESY AMERICAN MUSEUM OF NATURAL HISTORY

SOME ROCK-FORMING MINERALS

1. A crystal of the orthoclase variety of feldspar. 2. Needle-like crystals of hornblende in a schist. 3. A nodule of limonite, showing variations in color. 4. Amethystine variety of quartz on white quartz. 5. Olivine crystals (green).

6. A green variety of muscovite mica on quartz. 7. Crystals of calcite, tinted reddish by impurities. 8. A mass of biotite, or black mica. 9. Chlorite (green) with garnets (red). 10. Crystals of augite.

METAMORPHIC ROCKS

Modified after Kemp

CONTACT METAMORPHISM				REGIONAL METAMORPHISM				PRODUCTS OF WEATHERING
Original Sediments	Metamorphic Products	Gneisses Corresponding in Mineralogy to the Granitoid Igneous Rocks A few others.		Crystalline Schists	Quartzites and Slates	Crystalline Limestones	Ophicalcites, Serpentine, Soapstones	
		Derived from igneous	Derived from sedimentary					
Conglomerates and Sandstones	Effects relatively slight Quartzites	Granite gneiss or gneiss proper	Granitic gneiss or gneiss proper	(Mica Prominent) Mica schists often with garnet, staurolite, etc. Phyllites	Quartzites (Quartz schists)			Residual soils
Shales and Clays	Andalusite hornfels Lime-silicate hornfels Spotted slates	Syenite gneiss Diorite gneiss } Gabbro gneiss }	Syenitic gneiss Dioritic gneiss, etc. Conglomerate gneiss	(Hornblende Prominent) Hornblende schists often with garnet, epidote, scapolite Amphibolites		Marbles often with mica, tremolite, etc.	Serpentinous marble or ophicalcite, verd-antique	Subsoil
Limestones	Garnet, diopside, vesuvianite, epidote, wollastonite, scapolite, ores, introduced	Pyroxenite gneiss	Gneisses with a prominent mineral, such as biotite-gneiss, etc.	(Various Minerals Prominent) Chlorite schist or green schists Talc schists Glaucofan schists Quartz schists	Graywackes Slates (Phyllites)	Dolomites often with mica, tremolite, etc.	Serpentine often with chromite, garnet, etc. Soapstone or steatite	Laterites especially from basalt
Coals	Natural coke Anthracite	Peridotite gneiss						

rock have been washed away. Dolocasts are the insoluble minerals which remain when a powdered limestone or dolomite is treated with an acid. It has been found that these remnants are often quite characteristic of a given formation.

Over the surface of the globe, igneous rocks form about 95% of the crust to a depth of ten miles. At the surface the proportions of granitic (acid) rocks to basaltic (basic) ones is roughly two to one, contrasting with the predominance of the basic rocks when taking the earth as a whole. Of the remaining 5% of sediments, 82% is shale, 12% sandstone, and 6% limestone.

Although this discussion has been confined to the hard rocks, it should be remembered that, according to the definition, loose soil, SAND, and soft mud and CLAY, are just as much rocks as are granite and basalt. See also MINERALOGY; ORE DEPOSITS; GEOLOGY; GEO-CHEMISTRY; SEDIMENTATION; VOLCANISM; METAMORPHISM.

S.F.K.

BIBLIOGRAPHY—R. A. Daly, *Igneous Rocks and Their Origin*, 1914; Louis V. Pirsson, *Rocks and Rock Minerals*, 1915; Ernest Weinschenk (transl. by Albert Johannsen), *The Fundamental Principles of Petrology*, 1916; N. H. and A. N. Winchell, *Elements of Optical Mineralogy*, 1922.

PETRONIUS ARBITER, Roman author of a satirical romance, the *Petronii Arbitri Satirae* or *Satyricon* is identified with Gaius Petronius, a voluptuary

at the court of Nero. Tacitus, in a celebrated passage (*Annals* xvi, 18, 19), describes this Gaius Petronius as a profligate and aesthete possessing a fearless wit, who was an intimate associate of Nero, at whose court he played the part of *Arbiter elegantiae*. In consequence of the intrigues of his rivals, he lost the favor of Nero and was forced to commit suicide by opening his veins, in 66 A.D. Several hours before his death, we are told, he wrote a scathing description of the emperor's cruelty and debauchery, and sent the account to him under seal.

The remarkable work, the *Satyricon*, ascribed to Petronius, was written chiefly in prose, and dealt with the adventures of one Encolpius and his companions on a journey in southern Italy. It originally comprised about 20 books, but only fragments remain to us, being parts of books XV and XVI. The longest and most famous episode is entitled *Cena Trimalchionis* or *The Banquet of Trimalchio*. The work is a dramatic and realistic portrayal of the social life of the time. Aside from its literary value, it has greatly contributed to our knowledge of colloquial Latin.

BIBLIOGRAPHY.—*Cena Trimalchionis*, ed. by W. B. Sedgwick, 1925; translations of the *Satyricon* by J. M. Mitchell, 1923, W. Burnaby in *The Modern Library*, 1929, and others.

PETTY, SIR WILLIAM (1623-87), English political economist, was born at Romsey, Hampshire,

May 26, 1623. He studied medicine at Leyden and at Oxford where in 1648 he became professor of anatomy and chemistry. After the accession of Charles II in 1660, Petty was appointed surveyor-general of Ireland where he superintended a redistribution of lands. He analyzed the sources of wealth as labor and land, and won his reputation as an economist by his *Treatise on Taxes and Contributions* and *Political Arithmetic*. He died at London, Dec. 16, 1687.

PETUNIA, a numerous genus of handsome annuals and perennials of the nightshade family, various species of which are grown as showy garden flowers. There are about 25 species, natives of southern South America. They are mostly much branched, sticky-hairy plants of straggling growth, with soft leaves and large salverform white, purple or reddish flowers. The common garden petunia (*P. hybrida*) is a cultigen believed to include a series of hybrids derived chiefly from the white petunia (*P. axillaris*) and the violet-flowered petunia (*P. violacea*), both natives of Argentina. The numerous strains show great variation in the size, form and color of the flowers, which are often double or deeply fringed.

PETZITE, a steel gray to black, metallic mineral composed of gold, silver, and tellurium. It is of rare occurrence, but when found is a valuable gold and silver ore. See also TELLURIDE; ORE DEPOSITS.

PEWEE, a name applied to several birds of the American flycatcher family (*Tyrannidae*). The wood pewee (*Myiochanes virens*), about 6½ in. long, dark olive gray above and white below, is found in woodlands and shade trees widely in the eastern United States and Canada, wintering from Nicaragua to Peru. It is gentle in disposition and has a sad, sweet call resembling the syllables "pee-a-wee." Its food consists of insects caught by expert darts from a fixed perch on a dead branch. The pewee builds a shallow but compact, lichen-covered nest saddled on a tree limb, laying 3 or 4 white eggs with umber markings. The very similar western wood pewee (*M. richardsoni*), found west of the Great Plains from Canada to Lower California, and wintering in South America, is distinguished by its call, a quiet "tweer" or "deer." The PHOEBE is sometimes called pewee.

PEWTER, an alloy in which tin is the basic metal. The tin is usually mixed with lead, but antimony, bismuth, brass and copper are also used. There are three general classes of pewter: Common pewter, containing 4 parts of tin to 1 part of lead; trifle pewter, which is about 80% tin, 15% antimony and 5% lead; plate pewter, composed of 90% tin, about 7% antimony and the remainder copper and bismuth. If pewter contains more than 1 part of lead to 4 parts of tin, there is danger of substances coming in contact with the metal being poisoned by the lead. Pewter is a soft alloy, with color somewhat darker than that of tin. Up to about the middle of the 19th century, pewter was used extensively in churches, homes and public buildings, and was made into the form of cruets, flagons, plates, goblets and miscel-

laneous objects such as candlesticks and salt-cellars. Pewter vessels were extremely popular from the 16th through the 18th centuries in England and on the Continent. As a general rule the German and Swiss pieces were more heavily ornamented than the English. In America the pewterer's art flourished during the 18th century and the first half of the 19th, the plates and vessels being used chiefly for domestic purposes. Fine old pieces of pewter have become increasingly valuable, and in America they are much sought after by collectors of Early American antiques. See also TIN AND ITS ALLOYS.

PEYOTE, a North American Indian religious cult which has been rather widely diffused since the middle of the 19th century among the Indian tribes west of the Mississippi, though in earlier times it appears to have been widely known in Mexico and the Southwest. The chief feature is the use of the narcotic peyote (derived from the Nahuatl word, *peyotl*), a small cactus, which is like a radish in form and size. The downy white top of the root is sliced and dried and when eaten is said to produce visions. Like other North American Indian ceremonies, there is a prescribed ritual accompanied by dancing. In its more modern form, however, various Christian teachings have been incorporated in the peyote ritual.

PFORZHEIM, a city in the province of Baden, lying on the Enz River about 15 mi. southeast of Karlsruhe. It is the foremost German city in jewelry manufacturing and trade. Its buildings include a castle, a Gothic church, and many new buildings and monuments. Besides the jewelry industry, the city has a diversity of smaller industries. Pforzheim stands on the ruins of a Roman settlement, and it is first mentioned in authentic documents about 1000. Pop. 1925, 78,973.

pH, the symbol used in chemistry to indicate the *hydrogen-ion concentration* in solutions. The number following pH expresses the amount of concentration, and represents the logarithm of the reciprocal of the number of hydrogen ions present, in grams per liter. Thus pH 7, which is the value for a neutral solution and thus also for pure water, denotes that 10⁻⁷ grams of hydrogen ions are present per liter. More hydrogen ions are thus expressed by a smaller number, as small as 1, or 0 or even negative, for concentrated solutions of strong acids, while larger numbers indicate alkalinity, pH 14 being attained for a concentrated solution of sodium hydroxide. For determination and application, see HYDROGEN-ION CONCENTRATION.

PHACELIA, a genus of annual and perennial herbs of the waterleaf family, many of which are attractive flower-garden plants. There are about 120 species native chiefly to western North America and the Andean region; fully 100 are found in the United States, more than 50 occurring in California. They are mostly rough-hairy plants with alternate, often much divided leaves and blue, violet or white flowers in terminal, somewhat coiled (scorpioid) clusters. Among those best known in cultivation are the California bluebell

(*P. Whitlavia*) and the fiddleneck (*P. tanacetifolia*). Interesting wild species are the rock phacelia (*P. californica*), with exceedingly variable flowers, and the caterpillar phacelia (*P. hispida*), with the herbage densely covered with slender white bristles.



FROM JEPSON, MAN. FL. PLANTS CALIF., COPYRIGHT

ROCK PHACELIA

Leaf, flowering panicle, corolla spread open and cross section of the ovary

PHAEDRA, in Greek mythology, daughter of MINOS and PASIPHAE, was wife of THESEUS. She fell in love with her stepson, HIPPOLYTUS, and, when he did not return her love, made false accusations against him to her husband. At THESEUS's request POSEIDON destroyed HIPPOLYTUS. The deception was discovered and Phaedra killed herself.

PHAEDRUS (1st century A.D.), Latin fabulist, was born probably in Macedonia in the 1st century A.D. He was taken to Rome as a slave, but was freed under Augustus. He offended Seianus, minister of Tiberius, by some allusion in one of his fables, and was punished for it. His *Fabulae Aesopiae*, written in iambic verse, were popular for many centuries. Phaedrus is thought to have died in the reign of Claudius.

PHAETHON, in Greek mythology, son of the sun god HELIOS and Clymene. He begged his father to let him drive his chariot for one day. The fiery horses got beyond his control and took him too near the earth where he did great damage. Zeus in anger killed him with a thunderbolt.

PHAGOCYTOSIS, ingestion of foreign substances, including bacteria, by the polymorphonuclear variety of white blood cells known as phagocytes. These cells under normal conditions form about 60 to 75% of the white blood cells.

The power of the phagocytes to ingest foreign substances seems to depend upon the presence in the blood serum of certain substances called opsonins, which somehow prepare the bacteria and other foreign particles so that they may be absorbed by the white blood cells.

PHAINOPEPLA (*Phainopepla nitens*), a handsome bird of the silky flycatcher family (*Ptilgonatidae*) somewhat resembling the waxwings. It is about 8 in. long, with an erect crest, short rounded wings, a long fanshaped tail, and soft silky plumage. The male is glossy blue-black throughout, except for a conspicuous white patch on the wings; the female is mostly plain brownish gray. The phainopepla is a shy but active bird with a vivacious song, inhabiting arid regions of the southwestern United States and Mexico. It feeds principally on fruits, chiefly those of the pepper tree, juniper and mistletoe, but also on insects, which it captures on the wing in the manner of true flycatchers. The nest, in which are laid 2 or 3 spotted, grayish eggs, is placed in trees or large bushes.

PHALÆNOPSIS, a genus of tropical orchids yielding some of the best species for hothouse culture. There are about 50 species found chiefly in tropical Asia, Malaya and the Philippines. They are perching plants (epiphytic) with short stems bearing a few oblong, leathery, frequently mottled leaves and drooping clusters of showy flowers, very attractive in form and color but mostly white or whitish with rose or purple tints or over colors. Among the favorites grown by florists are *P. amabilis*, with white flowers stained with yellow and sparingly spotted with purple; *P. Aphrodite*, with white flowers marked with yellow and red, and *P. Sanderiana*, with rosy flowers variegated with brown, purple and yellow.

PHALANGER, a marsupial of the family *Phalangeridae*, inhabiting Australia and neighboring islands, called also cuscus. Phalangers have thick fur, long tails and short ears; the numerous species range in size from a few inches to two feet, and vary greatly in coloration. Some are terrestrial in habit, others arboreal, and still others fly in long, sweeping leaps. The larger species, as the Australian bush-tailed phalanger, furnish much of the "opossum" fur of commerce.

PHALANX, a military formation perfected by the Macedonians. It consisted of heavily armed infantry so that their ranks presented a solid front of spears to the enemy. This mass formation varied between 8 and 16 ranks deep. Under Philip II of Macedon the phalanx was reorganized, this formation being known as the Macedonian phalanx. For military purposes the phalanx was better for defense than it was for offense, it being too immobile for quick attack.

PHALAROPE, a family (*Phalaropodidae*) of small shore birds allied to the sandpipers but differing in their lobate feet, their dexterity in swimming, and their pronounced aquatic habits, often occurring in large flocks far out at sea. There are but three species, ranging from 7 to 9 in. in length, with the lower plumage thick and resistant to water, like that of a duck. The females, which are larger and brighter colored than the males, do the courting, while the males make the nest and incubate the eggs. Wilson's phalarope (*Steganopus tricolor*) is found chiefly in the interior of temperate North America, migrating in winter to Brazil and Patagonia. The remaining

species, the red phalarope (*Phalaropus fulicarius*) and the northern phalarope (*Lobipes lobatus*), are circumpolar in distribution, breeding in the arctic and wintering in the tropics.

PHANTASM, an appearance of a human form without material reality (see **GHOST**). It may be an **HALLUCINATION** or an **APPARITION** aroused by intense expectancy, anxiety or apprehension. That phantasms are evidence of the return of disembodied spirits is maintained by believers in spirit agency and in telepathic communications. The question is discussed more critically in **PSYCHICAL RESEARCH**. See also **MEDIUMS**

PHARISEES, a religious party, the leaders of the Jewish people in the period after the Maccabean wars for independence. They were the true expounders of Jewish teachings, doctrines and traditions. The Pharisees flourished during the latter part of the period of the Second Temple, and were opposed in all respects to the priestly and aristocratic **SADDUCEES**. Whatever the origin of their name, it seems certain that the Pharisees and their teachings go back to Ezra and his reforms, and that the final literary embodiment of their doctrines was the Talmud.

The Pharisees were vitally concerned with the preservation of Judaism, and were also the champions of strict morality. Their laws of ritual purity were so stringent that they kept themselves apart from the common people. They were actually the liberal thinkers of their day, for they declared that God could be worshiped in any place, and not necessarily in the Temple at Jerusalem. True to Jewish tradition, they sought always to show that the religious customs and practices observed were indicated in Scriptures. A prerequisite for admission to the ranks of the Pharisees was the strict observance of the laws of Levitical purity, in addition to laws and regulations of later origin. While they were to a great extent legalists, they endeavored to comply with the teachings of the Scriptures and to develop a Judaism which might be practiced under the yoke of the Romans. In contrast to the Sadducees, the Pharisees firmly believed in resurrection and in the coming of the Messiah from the tribe of David, also in reward and punishment after death. Such doctrines were set forth in fixed prayers. The laws prohibiting work on the Sabbath were strictly enforced, and new decrees were made to guard against all possible desecration of the day.

The Pharisees, despite the unfavorable conception of them offered in the New Testament, as being the implacable enemies of Jesus, hair-splitting legalists and rigid believers in the strict letter of the Law, were actually moral leaders of the Jewish people who struggled for the realization of the teachings of their Scriptures, in every-day, practical life. They established schools and synagogues in many places. They were concerned with the perpetuation of the Jewish religion and the Jewish people, the moral improvement of mankind, and the practice of altruism, humanity and ethical monotheism, principles which are ab-

solutely identical with those of the later rabbis. In politics they were not greatly interested at first, but later became separated from the aristocratic Sadducees more and more along political lines, and therefore were regarded as a democratic party, the political party of the common people. But they were generally much more concerned with the promotion of peace and of learning than with war, politics, or patriotism.

A. SH.

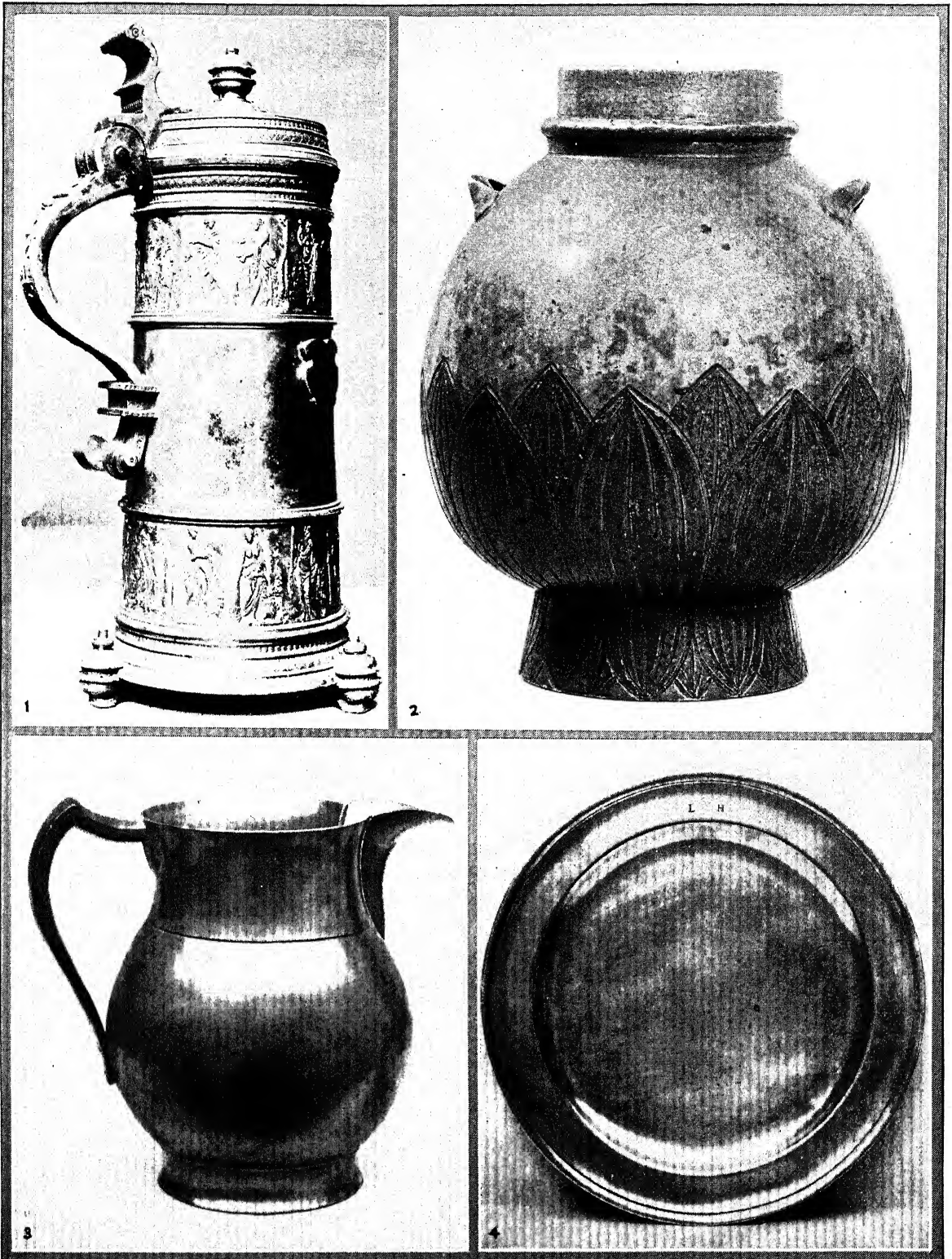
BIBLIOGRAPHY.—Israel Abrahams, *Studies in Pharisaism and the Gospels*, 1917; R. Travers Herford, *The Pharisees*, 1923, J. W. Lightley, *Jewish Sects and Parties in the Time of Christ*, 1925, Graetz, *History of the Jews*, 1926, Lauterbach, *The Pharisees and Their Teachings*, 1930

PHARMACOLOGY, the science of drugs. As a matter of convenience and usage, the subject is divided into subdivisions, each of which has its own special field. *Pharmacy* has been limited to the science which deals with the methods of *preparation* of drugs so as to make them suitable for administration for the prevention and cure of disease. *Pharmacognosy* is limited to a *description* of drugs, their origin and their botanical and chemical properties. *Toxicology* is applied to the study of *poisons*, their detection, the symptoms produced by them, and the mode of treatment. The *employment of drugs* for the prevention or cure of disease (another aspect of Pharmacology) is *Pharmaco-therapeutics*. The term therapeutics itself is applicable to the employment of many other forms of treatment than that by drugs. Such use of the term we find in hydrotherapy, electrotherapy, psychotherapy, etc., depending upon whether treatment is by water, electricity or by an effort to influence the patient's condition by an action through his cerebral processes.

The term Pharmacology, however, as used now is more restricted in its sphere and should perhaps be replaced by the more accurate but cumbersome term *Pharmacodynamics*. Briefly stated, by this term is meant the study of the action of drugs upon the living organism. Technically speaking, in this limited sense the term has to do with "the study of the changes produced in the living organism by the administration in the state of minute division of such unorganized substances as do not act as foods." By the limitation of this definition, the substance has to be introduced in the state of minute division, thus excluding purely mechanical effects such as would be produced in the body by a cut of a knife or by a ligature. So also are excluded from its study the action of organized substances such as microorganisms—these being assigned to bacteriology and pathology.

Pharmacology to-day has to a great extent replaced the old *Materia Medica*. It is one of the newest of medical sciences, dating only from the middle of the nineteenth century. The term *Materia Medica* treated largely of the sources of the drugs, their chemistry, and their properties and uses in so far as they were known. Pharmacology, however, studies the effects produced in the body by the drugs and from the facts thus gained utilization of the drugs in the practice of medicine follows. It is thus at the basis of so-called "rational therapeutics" as distinguished from

PEWTER

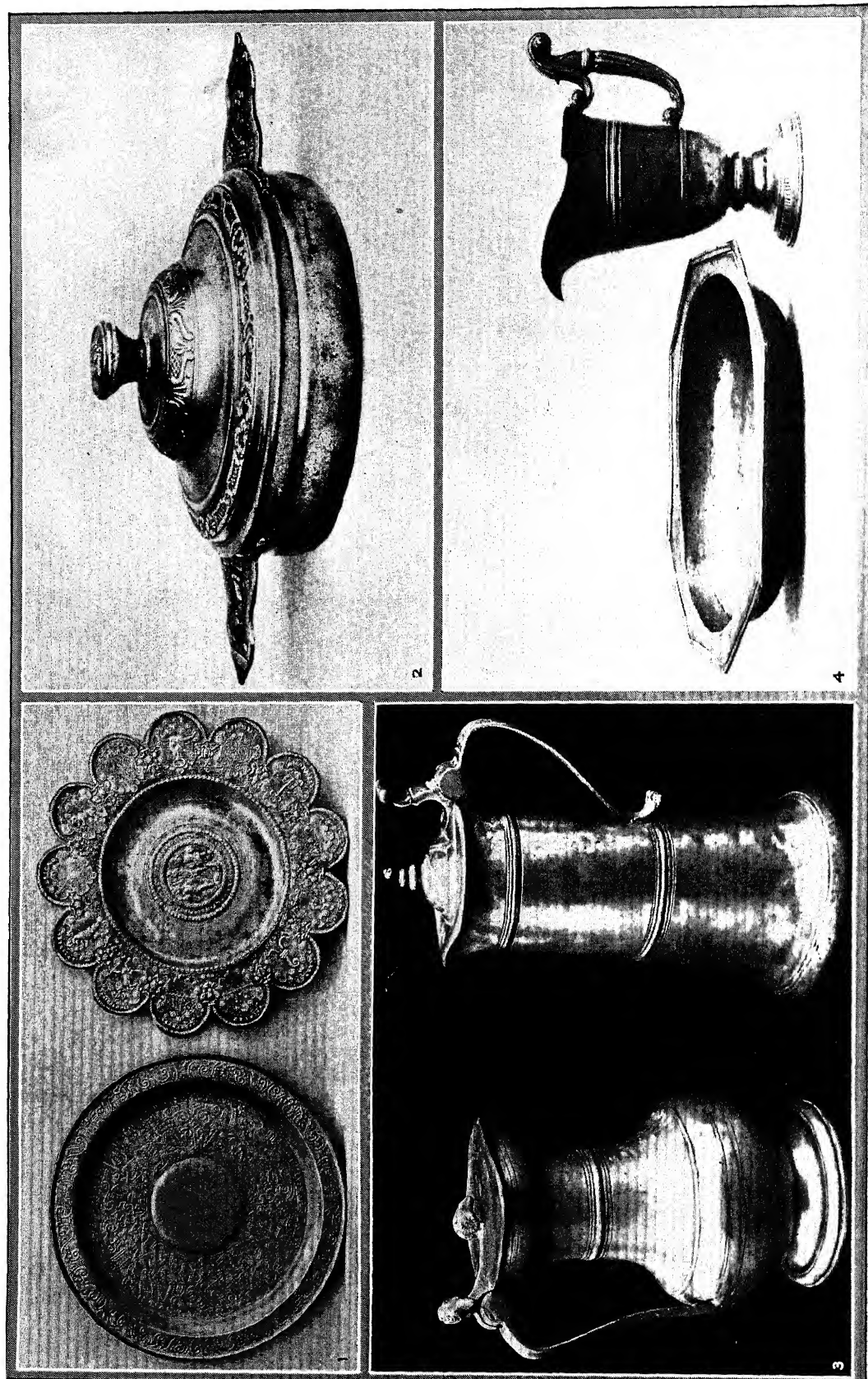


1, COURTESY VICTORIA AND ALBERT MUSEUM, LONDON; 2, 3, 4, METROPOLITAN MUSEUM OF ART

RARE OLD PEWTER—AMERICAN, GERMAN, JAPANESE

1. 16th century German silvered tankard, in the South Kensington Museum, London. 2. Japanese jar, 19th century.
3. American pitcher, probably 18th century, made by McQuilk of Philadelphia. 4. American plate of about 1750-75.

PEWTER



COURTESY METROPOLITAN MUSEUM OF ART

RARE AND GRACEFUL CONTINENTAL PEWTER

1. Left, German plate etched with figures of the four evangelists, 17th century; right, Swiss plate decorated with the crests of cantons, 16th century. 2. French porringer, early 18th century. 3. Swiss flagons of the 17th century. 4. Basin and ewer of about 1700 from Chambéry, France.

the old "empirical" mode of treatment. In empirical therapeutics the basis of the use of drugs is clinical experience. Someone in times past had used a drug in a certain condition and believed he saw good to result therefrom, so when a like condition again arose the same drug was naturally employed once more. From the earliest medical times until about the middle of the nineteenth century this was practically the only rule or basis for the employment of drugs for the cure of disease.

About that time systematic studies were initiated in order to ascertain what effects were produced in the animal body following the administration of substances which were classed as drugs. This experimental work constituted the beginning of Pharmacology and from the facts thus gained modern therapeutic progress may be said to date. Not only the old drugs which had been in use for so many years were studied, but new drugs, as they emerged from the chemical laboratories, were subjected to like scrutiny. If these studies indicated that the drug possessed desirable properties, it was tried out at the bedside in conditions in which its action as shown in the laboratory might indicate that it would probably be useful. Such therapeutics, then, are designated as rational therapeutics and they are the direct result of pharmacological studies carried out in laboratories.

Of course, such results emanating from laboratories had to be confirmed at the bedside, as we have seen, and much of value has been added to therapeutics from similar careful observations carried out upon sick persons. This branch of study may properly be termed *Clinical Pharmacology* since it is carried out in the clinic.

Under the old empirical practice, comparatively few drugs had really established themselves as being of real value. Among these may be mentioned opium for the relief of pain; the salicylates for arthritis; quinine for malaria and digitalis for heart disease. On the other hand, as a result of pharmacological study in the last fifty years, we have had all the modern sleep-producing drugs introduced; all the local anesthetics; all the arsenic and bismuth preparations for the treatment of syphilis; all the modern pain-relieving and temperature lowering drugs and hosts of others too numerous to mention. These drugs have, as stated, been introduced into the practice of medicine as a result of pharmacological studies, but for every drug found valuable by such study dozens of others have been found to be worthless and have been tossed into the discard. In this way Pharmacology serves the public by selecting the good and sifting out the worthless. See also THERAPEUTICS. C. W. E.

PHARMACOPOEIAS, books on standards of medicinal drugs compiled and issued under a recognized authority, which in European countries is the government. In the United States, the pharmacopoeia is the product of a convention of delegates appointed by medical and pharmaceutical colleges and societies and by the U. S. Government Services directly interested in this work. Even though not directly emanat-

ing from the government, the United States Pharmacopoeia (abbreviated U.S.P.) has had the status of a law book, conferred upon it in the "pure foods and drugs acts" passed by Congress and many state legislatures.

It is evident that the pharmacopoeias of the world constitute in their totality one of the greatest of the assets of civilization, having their origin, among the oldest of human documents, many of which, e.g., the Papyrus Ebers, are nothing more or less than recipe books. From such roots sprang the formulas contained in the books of Hippocrates and of Galen, the latter of which maintained such sway over pharmacy and medicine for more than a thousand years, that preparations of the kind contained in Galen's writings—they were all of vegetable drugs—are still called "galenic preparations" or "galenicals." More direct precursors of the present pharmacopoeias were the "*Antidotaria*," which appeared toward the end of the Middle Ages. The flood of formularies that followed was responsible for the realization of the need of some authoritative or official standard to serve a community. The city of Nürnberg was the first, through its senate, to respond to this requirement with legislative enactment in 1529; and after years of study adopted, in 1546, the *Dispensatorium* of Valerius Cordus, with the requirement that druggists prepare their medicines according to its formulas. This was soon followed by other city formularies, which now came to be called pharmacopoeias, a term derived from the Greek, meaning "drug-making" books. With the rise of nationalism, these city pharmacopoeias became national pharmacopoeias. To keep these books as far as possible abreast with scientific progress, periodic revisions are undertaken. The task of revising the U. S. Pharmacopoeia devolves upon a group of fifty men, who are elected by the pharmacopoeial convention, which meets decennially at Washington, D.C. So great is the need or general acceptance of scientific standards for medicines, that one may foresee the time when an international pharmacopoeia will appear, the beginning of which has been made (1902) in the form of the "International Conference for the Unification of Formulas of Heroic Medicaments," that in its "International Protocol" endeavors to formulate standards for potent remedies acceptable and accepted by all the pharmacopoeias of the world. B. F.

PHARMACY, SCHOOLS OF, in the United States are chiefly professional schools in universities, particularly in state universities. Their standards were at a low level until 1900, when the American Association of Colleges of Pharmacy was organized. Through the work of this association standards have been raised. Present-day schools of pharmacy require of entering students four years of high school training or the equivalent. Prior to 1932 the degrees of Ph.G. and Ph.C. were granted after three years of college work; but in 1932 most states made a four-year course compulsory and the B.Sc. in Phar. the minimum degree. The better schools offer graduate

courses leading to the degrees of MSc. in Phar. or Phar.D. Graduates before they can practice must be licensed by the Board of Examiners of their state. In 1931 there were 67 schools of pharmacy in the United States.

See *Journal of the American Pharmaceutical Association*; *American Journal of Pharmacy*, catalogues of state universities.

PHARSALUS, BATTLE OF, 48 B.C., a battle fought during the Civil War of Caesar and Pompey, between the army of Pompey, about 60,000 strong, against the legions of Caesar, numbering about 25,000. The two armies massed on the plains near Pharsalus, in Greece. After close fighting, Pompey's whole army was defeated, with losses of 15,000 killed and 24,000 prisoners. Caesar lost not more than 30 centurions and 200 men. After Pompey escaped to Egypt and his power was broken, Caesar pardoned the Pompeian prisoners. The battle marked the end of serious republican opposition to Caesar's plans.

PHARYNGITIS. The pharynx is that part of the throat between the tongue and soft palate and the esophagus. It is continuous with the esophagus and also communicates with the larynx, nose and eustachian tubes.

Acute pharyngitis or inflammation of the pharynx, is commonly known as "sore throat." It often occurs as a part of a "cold," and may be epidemic. It follows exposure to cold weather and chilling, and may be associated with digestive disturbance or some constitutional disease, such as rheumatism or gout.

The symptoms consist of tickling in the throat and irritation, producing much coughing. There is moderate pain in the throat upon swallowing. The membrane lining the throat is deep red and swollen. The throat feels dry and the secretions are diminished. In a day or two the throat is covered with mucus, which becomes thick and plentiful. The neck muscles may feel stiff and the lymph glands in the neck are often swollen and slightly tender. Usually there is some fever and fatigue.

Acute pharyngitis usually lasts a few days and requires only mild measures for relief. A salt solution may be used as a spray into the nose and throat. A solution of baking soda may be employed as a gargle. Cold compresses or an ice-bag applied to the neck help to give relief from pain. If the fever is high, such drugs as the salicylates are of value. A laxative is often useful.

Chronic pharyngitis may occur as a result of repeated attacks of acute inflammation. It is seen often in persons who smoke or drink to excess and in those who use the voice very much. Chronic discharge from the nose, or chronic inflammation of the lining membrane of the nose is often associated with chronic pharyngitis.

There are three types of chronic pharyngitis. In the first type, the back of the throat and roof of the mouth are red, somewhat swollen and covered with mucus. In the second type, there are small round swellings made up of lymphoid tissue on the back wall of the throat. The veins near these swellings are swollen

and there is excessive secretion of mucus. In the third type, the membrane lining the throat is dry and glistening.

The symptoms are similar for all three types. There may be some hoarseness, and a frequent irritable cough. There is much thick mucus in the upper part of the throat, and difficult expectoration.

In treating this disorder, the general health must receive attention. If possible, the cause should be removed. The use of food too hot, too cold or too highly seasoned should be forbidden. When the condition is caused by excessive use of the voice, rest is necessary. It may not be possible to cure it in those who smoke without stopping the use of tobacco.

Gargles and sprays of various sorts may give relief. In the second type it may be necessary to destroy the swellings by using galvano-cautery. W. I. F.

PHASE, the instant of time when any specified part of a simple HARMONIC MOTION occurs.

PHASE, ELECTRICAL, the position of a reference point on an ALTERNATING-CURRENT wave at a given instant of time. The reference point taken is usually the zero point in the positive direction of a graphic representation of the wave. The phase angle between two alternating currents or between an alternating current and its potential is the angle between their reference points at a given instant of time, a complete cycle, or wave, being taken as 360° .

A *single-phase* system is an alternating-current circuit which carries a single current. A *two-phase* system is one which carries two currents of equal strength but differing in phase by 90° . A *three-phase* system employs three currents of equal strength but differing in phase by 120° . The term *polyphase* is applied to circuits of two or more phases. The circuits of alternating-current machines may be single phase or polyphase.

PHASE CONVERTER. See CONVERTER, ELECTRIC.

PHASE METER. See INSTRUMENTS, ELECTRICAL.

PHASE RULE, one of the most important laws of physical chemistry, first enunciated by WILLARD GIBBS, states the conditions under which can coexist a number of different solids, liquids, and gases. The salient characteristics required in the description of such a system are the number of phases, P , of compounds, C , and of degrees of freedom, F . By the phases are understood all the different homogeneous parts of such a system, that is to say, the total number of different solids, liquids and gases; but, since all gases intermix completely, never more than one gaseous phase can be present. The number of compounds equals the number of chemical substances, provided no reaction takes place between them. The degrees of freedom denote the number of independent ways in which the temperature, volume, and pressure of the system can be changed. The phase rule, then, states that $F = C + 2 - P$. Thus, in the simple case of one substance present as a gas and a liquid, C is equal to 1, P to 2 and hence F to 1, which means there is still one relation to choose between the vol-

ume, pressure, and temperature, which in this case would indicate the change in vapor pressure with temperature. If only one phase is present, say a gas, F equals 2 and both pressure and temperature can be changed at will, while in the case of one substance being present as solid, liquid, and vapor, P equals 3 and hence F is zero; the system is completely determined. Such a case would occur if a space were entirely filled with ice, water, and steam which can then exist simultaneously only if temperature, pressure, and volume have certain definite values. If the temperature is too high, the ice will melt; if it is too low, the water will freeze; if the pressure is too great, the steam will condense, etc. Where different substances are present in several phases, the problem becomes extremely complicated, but even here the phase rule gives notable help toward the solution. W. J. L.

PHEASANT, a bird (*Phasianus colchicus*), long ago acclimated in Britain as a game bird, but now much hybridized with the Chinese ring-necked pheasant. These hybrids were brought to the United States about 1900, and now are wide-spread; other Oriental species have been introduced on the Pacific Coast. Pheasants are forest birds, and over 100 species are scattered from Persia to the Philippine Islands, with India as the center of abundance. The females and young are plainly colored and silent, as the safety of the family requires, since all nest on the ground. The cocks, however, show gorgeous coloring and ornaments, especially in the wings and tails; and in a conscious exhibition display these fine feathers in their wooing before the demure hens. The argus is renowned for its broad, richly ocellated wings and tail, whose spread may equal that of the peacocks. The monauls of the Himalayas are crested with metallic green plumes and wear copper tints, purple and greens in a bewildering mixture. Reeves's pheasant has a black and white banded tail, 5 ft. long; other varieties include gold, silver, and copper species, named from their plumages. Pheasants do well in captivity, so that visitors to zoological gardens are able to see many living examples. Jungle fowls, progenitors of all domestic poultry, and pea fowls are members of the pheasant family (*Phasianidae*). E. I.

PHEASANT'S-EYE, a name given to the cultivated species of *Adonis*, small plants of the crowfoot family bearing yellow or crimson flowers, sometimes with a darker center. See *ADONIS*.

PHEASANT SHOOTING, a sport popular in the United States and England. The original home of the pheasant was in Asia. Of the many species, several have been introduced into North America. The pheasant stands the American climate well and has become an important game bird in some of the eastern states. In England, where pheasants have been bred on private preserves for many years, enormous numbers are killed each season. They are almost always driven by beaters toward the guns; but in the United States are shot over dogs, like quail or partridge. The average load for pheasant is $3\frac{1}{2}$ drams of smokeless powder and $1\frac{1}{8}$ ounces of No. 3 or 4 shot.

Pheasants like a warm, sheltered wood, with open spaces to admit light and sunshine. They prefer a spot watered by a stream or pond with thick underbrush and good-sized trees to roost in. The pheasant has a habit of leaving his home woods in the early morning and making a trip to a cool, damp place, as the edge of a stream, which he may follow for miles. Unlike other game birds, pheasants keep on the move all day in fair weather, seldom stopping to sun and dust themselves as do quail. In bad weather they are apt to stay quietly in the home woods.

See Aymer Maxwell, *Pheasant and Covert Shooting*, 1913.

HELPS, WILLIAM LYON (1865-), American educator, was born in New Haven, Conn., Jan. 2, 1865. He graduated in 1887 at Yale, where he served as instructor in English literature from 1892-96; assistant professor of English language and literature, 1896-1901, and in the latter year became Lampson professor. Phelps has edited several editions of classics, published numerous critical works on literature and the drama, and lectured extensively on modern authors and their works. His books include *As I Like It*, 1923; *Adventures and Confessions*, 1926, and *Happiness*, 1926.

HELPS-GORHAM PURCHASE. In 1786 the controversy over title to western New York, within the charter limits of both New York and Massachusetts, was settled by compromise. Ownership, with only a small area about Buffalo excepted, was given to Massachusetts, while New York retained sovereignty. Oliver Phelps and Nathaniel Gorham, merchants and speculators, purchased the area of 6,000,000 acres from the State of Massachusetts for \$1,000,000, a third of the sum in cash. They extinguished the Iroquois title to some 2,000,000 acres, and at Canandaigua, 1789, opened a land office. Unable to make full payment to Massachusetts, they surrendered to the state the remaining 4,000,000 acres. In Nov. 1790 Phelps and Gorham sold their holdings to ROBERT MORRIS, who in turn sold the tract to the HOLLAND LAND CO.

PHENACETINE, a trade name for ACETPHENETIDINE.

PHENAZONE. See ANTIPYRINE.

PHENIX CITY, a city of eastern Alabama, in Lee Co., across the Chattahoochee River from Columbus, Ga., of which it is a suburb. The Central of Georgia Railroad serves the community which is both residential and industrial. The retail trade in 1929 amounted to \$1,380,710. It was founded about 1860 and incorporated in 1883. In 1923, the cities of Phenix and Girard were consolidated, which more than doubled the population of Phenix City. Pop. 1920, 5,432; 1930, 13,862.

PHENOCRYST. See PORPHYRY.

PHENOL, or **CARBOLIC ACID**, a highly caustic organic acid (C_6H_5OH), obtained from coal tar by fractional distillation or made synthetically. In pure form it occurs as colorless needle-shaped crystals or a white crystalline mass, having a typical aromatic odor, soluble in water 1 to 15 and miscible in alcohol in

all proportions. Phenol is employed chiefly as an antiseptic and germicide; it also acts as a local anesthetic. Internally, it is caustic and poisonous. The substance is taken as a standard for comparing the relative activity of phenol-like disinfectants known by the expression "phenol coefficient."

PHENOL CONDENSATION PRODUCTS.

See RESINS, SYNTHETIC.

PHENOLPHTHALEIN, a dibasic phenol derivative, formula $(C_6H_4OH)_2CO \cdot C_6H_4CO$, produced by the interaction of PHENOL and phthalic anhydride; occurring as white or faintly yellowish white crystalline powder; insoluble in water and freely soluble in alcohol. The solutions in acid liquids are colorless, but turn red as soon as the liquid becomes slightly alkaline; it, therefore, finds extensive use in quantitative chemistry as a color indicator for volumetric assays (see ACIDIMETRY; ALKALIMETRY; INDICATORS). In medicine it acts on the large intestine as a purgative and is a common ingredient of a host of proprietary preparations, oftentimes incorporated in a candy medium.

P. N. L.

PHENOMENALISM, a philosophical position confining knowledge to appearance. It is therefore apt to make a distinction between appearance and reality, although in some of its phases it is not greatly interested in this question. When it does make this distinction, however, it takes the form of TRANSCENDENTALISM, as with IMMANUEL KANT; when such an issue is more or less ignored, as with AUGUSTE COMTE, it takes the form of POSITIVISM. The phenomenalism of Kant would make reality not only unknown but unknowable; the positivism of Comte would confine interest to knowledge of phenomena without entering upon metaphysical questions regarding reality.

PHENOMENOLOGY, a philosophical term that came into prominence through GEORG WILHELM FRIEDRICH HEGEL in connection with his *Phenomenology of Spirit*. It regards all appearances as manifestations of an underlying and self-developing principle of reality. Customs and institutions, art, religion and science are but outer manifestations of this indwelling spirit of the world. From the most simple act of perception knowledge is traced through its developing stages until it reaches the Absolute. History is this Absolute revealing and realizing himself through events.

PHENYLBENZENE. See DIPHENYL.

PHI BETA KAPPA. See FRATERNITIES, COLLEGE.

PHIDIAS, the greatest of all the incomparable sculptors of ancient Greece, was born in Athens about 500 B.C. He became the close friend of the statesman Pericles, but through political enemies was imprisoned for "impiety," and died in prison in 432 B.C. His impiety consisted in depicting his own likeness and that of Pericles in a battlescene on the shield of the goddess *Athena*. A copy of this shield, the Strangford shield, is in the British Museum.

Phidias worked in bronze, marble, gold and ivory, on a wide variety of subjects, producing statues of idealistic dignity, serenity and nobility. His two masterpieces were the colossal chryselephantine statues

of Zeus at Olympia, and Athena in the Parthenon. No originals survive, and the only copies of these are small and unsatisfactory. The sculptures of the Parthenon pediments and frieze may possibly be from his designs.

PHILADELPHIA, the 3rd largest city of the United States and the chief municipality of Pennsylvania. The city is mainly built on the peninsula between the Schuylkill River, flowing from the northwest, and the west bank of the Delaware, flowing from the northeast, in the southeastern corner of the state. Although its site, which in 1930 covered 129.7 sq. mi., is 101 mi. distant from the Atlantic Ocean, Philadelphia is an important port of entry and the center of a United States customs district. Philadelphia is the second great gateway city of the Atlantic Coast; its advantages for trade and manufacture are much like



LEMNIAN ATHENA OF
PHIDIAS

In the Albertinum, Dresden

those of New York, except that it has no lowland route connecting it with the interior of the country. The population in 1920 was 1,823,779; in 1930, 1,950,961, an increase of 7% in ten years. Historic Independence Hall is at 39° 56' 57.54" N. lat. and 75° 8' 57.5" W. long. The metropolis is coextensive with Philadelphia Co. In January the average temperature at Philadelphia is 33° F., in July 76° F. The average annual precipitation is 40.4 in.

Geographic Setting. The growth of the city has been partly due to its strategic position at the head of ocean navigation and to its proximity to the anthracite coal fields. The city extends southwest from the peninsula over the Schuylkill, and due south to the westward bend in the Delaware. Philadelphia is a "fall line" city. The Schuylkill River forms the eastern boundary, with Camden, N.J., on the east bank; the city boundary on the south is a line running east and west which separates Hog and League islands from the municipality; on the west and north the boundaries are defined by the lines of Delaware, Montgomery and Bucks counties. The original site of colonial Philadelphia was bounded by the rivers on the east and west, by the present Vine Street on the north and by South Street, formerly Cedar Street, on the south. The later industrial city spread north and east from lower Germantown to the Delaware River, and the modern residential section was developed on the farther bank of the Schuylkill, the present-day West Philadelphia, which together with Germantown and Chestnut Hill makes up the largest part of

Philadelphia's residential section. The city is 24½ mi. long from northeast to southwest, and 15 mi. wide from the Schuylkill at Roxborough to the Delaware at Torresdale. A good part of northeast Philadelphia, which extends to Poquessing Creek, is open country, dotted by communities much like independent towns and villages. In the north and west the ground is high, reaching an elevation at Germantown of 400 ft. above sea level. The land near the Schuylkill and Delaware is flat and low. The Delaware water front extends around the city in a southwesterly curve for 23 mi. from Poquessing Creek to Tinicum Island, and its west bank is lined with pier and dock facilities.

Streets and Buildings. Although one of the oldest urban communities in America, Philadelphia is modern in street plan. The plan was devised by Capt. Thomas Holme, 1624-95, first surveyor-general for William Penn, who laid out a parallelogram, 10,922 ft., 5 in. east and west, and 5,370 ft., 8 in. north and south. Philadelphia soon outgrew the 2 sq. mi. in this area, but Holme's successors retained the orderly arrangement. The present-day city has 2,000 streets; each square is allotted 100 numbers, and houses are numbered decimally. The numbered streets extend parallel with Broad, and the named streets with Market. In the historic section, the chief thoroughfares are Broad Street, running 11.7 mi. up and down by the approximate center of the peninsula, and Market Street, bisecting the peninsula east to west; Broad is 113 ft. wide and Market 110 ft. wide. In the old quarter the narrow streets are flanked by Georgian dwellings which give Philadelphia a distinctive charm. Broad Street reaches Penn Square at Market Street, which divides the city north and south. Market Street is the chief commercial thoroughfare and provides space on its 2 mi. length for the Pennsylvania Station, the Reading Station and the Post Office. Important east-and-west streets, parallel to Market, are Walnut, Locust, Spruce and Pine. Other leading thoroughfares are Fairmount Parkway, a magnificent boulevard, 6,300 ft. in length, and varying from 140 to 250 ft. in width, which runs from Fairmount Park, extending on both banks of the Schuylkill to City Hall; it was constructed at a cost of \$30,000,000; along its length are the Free Public Library, in Renaissance architecture, the classic Pennsylvania Art Museum, opened in 1928 and constructed at a cost of \$20,000,000, and the Rodin Museum, a reproduction of the famous Musée at Meudon, France. Roosevelt Boulevard links Fairmount to Pennypack Park by way of its winding drive through the northeastern section. The Delaware water front is flanked by Delaware Avenue, varying from 150 to 250 ft. in width, and extending north and south for 17 mi.; the street is crossed by elevated freight bridges and by belt line connections to the modern municipal piers and is given over to shipping, warehouses and the wholesale trade. In southeastern Philadelphia is the foreign quarter, made up mainly of Italians. The aristocratic streets converge on RITTENHOUSE SQUARE, a few blocks southwest of City Hall.

INDEPENDENCE HALL, in Independence Square, has first rank among the historic buildings in Philadelphia. An excellent example of colonial architecture, it was built in 1735. The Second Continental Congress met in the building May 10, 1775, and it was the scene a month later of Washington's appointment as commander-in-chief of the American army. It is even more celebrated, however, as the place of adoption of the Declaration of Independence on July 4, 1776, after which ceremony the bell was rung to proclaim liberty. The famous Liberty Bell has been preserved and may be viewed by visitors. West of Independence Hall is Congress Hall, scene of Washington's inauguration; east of Independence Hall, and also in the square, is the old city hall. More spectacular is the architectural pile, designed in French Renaissance style, known as City Hall, which covers 4½ acres; it was erected in 1872 at a cost of \$25,000,000 and is topped by an immense statue of William Penn, 547 ft., 11¼ in. from the ground. Educational edifices worthy of note, besides the new Art Museum previously mentioned, include the Art Club and Horticultural Hall, Girard College, Academy of Music, the buildings of the University of Pennsylvania along the west bank of the Schuylkill, and of Temple University on North Broad Street. Old St. Peter's and Christ Church, both early colonial buildings, the Gothic St. Mark's and Old Swedes' Church, are interesting architecturally. The United States Mint is an impressive structure. Many skyscrapers have been constructed in the downtown sections of the city.

Parks and Monuments. There are 7,000 acres of parks. Fairmount Park, enhanced by the Schuylkill winding throughout its length, is 3,597 acres in extent; Pennypack Park is 1,097 acres; Cobb's Creek, 612 acres, and League Island, 275 acres, at the confluence of the two rivers. League Island is also the site of the United States Navy Yard. In addition there are hundreds of acres of park driveways and squares, adorned with statues, historic tablets and memorials. Independence Square, on Chestnut Street between Fifth and Sixth streets, southeast of City Hall, its neighbor Washington Square, and Franklin and Rittenhouse squares are restricted areas celebrated in the history of the city and nation. Monuments include the Soldiers' and Sailors' Memorial in Fairmount Park and the Washington Monument at the head of the Parkway; the city is generously endowed with statues of Washington, one of which faces Independence Hall, Franklin, Girard, Lincoln, Grant, Garfield, Leif Ericsson, Columbus and other historical American figures. National shrines include Benjamin Franklin's grave and the house in which Betsy Ross made the first American flag.

Transportation. Philadelphia is the home city of the Pennsylvania Railroad system, extending from the Atlantic Coast to the Mississippi, and the city is also served by the Philadelphia and Reading and the Baltimore and Ohio railroads. The Delaware municipal docks and private piers are equipped to

handle transatlantic, coastwise and West Indian shipping. The Philadelphia Municipal Airport connects the city with the coastal air services and is a terminal of the transcontinental air line of the Pennsylvania Railroad. Within the city transportation is provided by street cars covering 721 mi. The Philadelphia Rapid Transit Co. and the municipality operate a subway system, augmented in 1928 and 1930 by the North Broad Street subway and the South Broad Street subway which cost \$111,000,000. Elevated lines and a comprehensive bus network provide additional facilities. The city is connected with Camden, N.J., by the Delaware Bridge, completed in 1928 at a cost of \$37,196,971, the longest span of which is 1,750 ft., and the Tacony-Palmyra Bridge, costing \$4,000,000 and completed in 1929. A series of railroad and vehicular bridges cross the Schuylkill River.

Commerce and Industry. Because Philadelphia is a great seaport and railway center, it also is a great manufacturing center. The extent of Philadelphia's commerce and industry is indicated by the value of total exports and imports in 1930, amounting to \$274,123,998. The value of manufactures in 1929 was about \$1,980,000,000. In the same year the eight leading manufactured products were printed and published material, knitted goods, cane sugar (refined), electrical machinery, apparatus and supplies, men's clothing, cotton goods, foundry and machine shop products, and carpets and rugs. During 1929 the retail trade amounted to \$1,122,168,131; the wholesale trade of Philadelphia Co., all establishments, was valued at \$2,265,489,053. Immediately outside the city coal, steel and cement are produced in great quantities; locomotives, street cars and hardware are also made in the district beyond the city limits.

History. In the 17th century Swedes and Dutch made settlements on the Philadelphia site. In 1681 WILLIAM PENN obtained a charter from Charles II to establish a commonwealth in Pennsylvania and was appointed governor of his group of 800 Quaker co-religionists. The settlement grew rapidly, and for 40 years in the middle of the 18th century Philadelphia was the home of the energetic BENJAMIN FRANKLIN, who dominated the town. The first Continental Congress met in the city on Sept. 5, 1774, but between Sept. 27, 1777 and June 18, 1778, Philadelphia was occupied by the British. In 1793 and 1798 epidemics of yellow fever caused huge depletions in the population. During the early 19th century Philadelphia was in all respects the leading city of the United States. Its residents were strongly opposed to slavery and took leading political and military roles during the Civil War. In 1876 the Philadelphia Exposition celebrated the centennial of American Independence, and in 1926 another elaborate exposition was staged to commemorate the sesquicentennial.

BIBLIOGRAPHY.—J. T. Scharf and Thompson Westcott, *History of Philadelphia, 1609-1884*, 1884; V Brandt and H. Gummere, *Byways and Boulevards in and About Historic Philadelphia*, 1925; H. M. Lippincott, *Philadelphia*, 1926.

PHILADELPHUS, a genus of flowering shrubs of the saxifrage family, commonly called mock orange, or syringa and widely cultivated for ornament. About 35 species, mostly Asiatic and American, are recognized, with many hybrids and varieties. They are for the most part erect shrubs, with simple, opposite leaves and white, often heavily fragrant, flowers. Noteworthy species are the garden syringa (*P. coronatus*), the scentless syringa (*P. inodorus*) of the southern Atlantic states, and the western syringa (*P. Lewisii*), which is the state flower of Idaho.

PHILANTHROPY, in its broad sense, the spirit of active good will toward mankind, as manifested by efforts to promote social welfare. In ancient and medieval civilization this benevolence was most commonly expressed by almsgiving, an act which was held by many religions as evidence of piety and consequently, a guarantee of spiritual salvation. In the modern sense, philanthropy has lost its connotation of love of mankind and of individual charity, and may be defined as active humanitarianism expressed on a large scale through foundations and other public institutions manned by experts in the fields of public health, education, religion and political reform. Thus modern philanthropy proposes to benefit the individual to the end of improving the social community, as distinct from ancient and medieval charity, which was often a perfunctory gesture of obeisance to the church. In the modern understanding of the word philanthropy dates from about the end of the 18th century. In England John Howard (1726-90) raised sums to provide prison reform, and Sir Samuel Romilly (1757-1818) was active in revising the harsh features of criminal law. In Europe the deaf and dumb were materially aided by the Abbé Charles Michel de l'Épée (1712-89). In the 19th century the industrialization of urban communities in Europe and the United States presented various social evils, the correction of which was very nearly essential to the preservation of industry itself. These evils, or social problems, involved housing, public health, education, religion and allied subjects. In increasing numbers, men whose fortunes were made by the new industrialization contributed their wealth to the amelioration of antisocial aspects of modern society, supporting such agencies as the Charity Organization Society, established in England in 1869, and in the United States in 1877. Later, in the 20th century, certain philanthropists included the fostering of the fine arts in the work laid out for their foundations and public trusts (*see* FOUNDATIONS). Unique examples of social philanthropy in the United States are Hull House in Chicago, Ill., founded in 1889 by Jane Addams, and the Henry Street Settlement in New York City. Examples of educational philanthropy in that country include the benefactions of Peter Cooper, Ezra Cornell, Matthew Vassar, Johns Hopkins, John D. Rockefeller and Edward S. Harkness. The Julius Rosenwald Fund, established in 1912, was dedicated to the well-being of mankind and has been used to better the living conditions and the educational facilities.

ties of the Negroes. The Russell Sage Foundation, established in 1907, is active in education, recreational work, social education, library establishment and the publication of social data. The gross income of philanthropy in the United States reached a stupendous sum after the World War, estimated in 1927 at \$2,219,700,000. In 1929 the sum total expanded in philanthropy was estimated at \$2,450,720,000, and was divided as follows:

Religious Purposes	\$996,300,000
Education	467,500,000
Personal Charity	279,760,000
Organized Charity	278,710,000
Health	221,510,000
Foreign Relief	132,000,000
Fine Arts	40,000,000
Play-recreation	20,000,000
Misc. Reform Organizations	14,040,000

The average sum expended annually in the United States on philanthropic enterprises in the five-year period ending Jan. 1, 1930, was \$2,252,346,000.

PHILATELY, the study of postage-stamps or other labels used to send matter through the mails, and the collection of such stamps. Philately dates from a few years after 1653, in which year the Comte de Villayer established a private postal service in Paris. But it was not until the early 19th century that stamp-collectors began to exchange notes on the private postal-labels and franks used in different countries. After 1840, when the first public postal system was established in England, and when stamps consequently attracted general interest throughout Europe, philately began to attain the stature of a serious historical study. In the decade following the first appearance of federal stamps in England, postage-stamps appeared in the United States (1847), Brazil, and in most European countries, and collections were soon begun in every civilized community throughout the world. The growing development in means of mail transmission gave rise to new stamp issues, each bearing an individual color, shape, lithographic impression, water-mark, type of denomination, type of perforation, etc. To-day philately enjoys an enormous international popularity, and its devotees spend annually hundreds of thousands of dollars in adding to their collections. Every year adds many new volumes to the considerable existing literature on philately, and the completeness of dealers' catalogues issued annually is further evidence of the hold of stamp-collecting on people everywhere. It employs a peculiar nomenclature, known to all serious philatelists; thus "water-marks" are those crowns, stars, anchors, or other design made while the stamp-paper is in process of manufacture; the separations between stamps (in a sheet) are variously known as *percé en lignes*, *percé en points*, *percé en arc*, *percé en scie*, *percé en serpent*, and *percé en losanges*; an inverted stamp in an otherwise perfect sheet is known as a *tête-bêche*. The word *philately* is also modern, an etymological union, suggested by M. Herpin of Paris, of the Greek *philos*, and *atelia*, meaning "exempt from tax."

Among the rarest stamps are the two types of 2-cent stamps, issued Oct. 1, 1851, by the Hawaiian Islands, the British Guiana 2-cent stamp of 1851, the early issues of Mauritius (a 1-penny stamp of 1847 is valued at \$20,000), and the Provisional issues by United States postmasters before 1847 (a 5-cent stamp impressed on an envelope by the Alexandria, Va., postmaster, dated 1845, is valued at \$15,000); but these and other rare items, all cancelled, have sold for more than \$30,000 at various auctions. The introduction of mail transmission by airplane has opened a new field of philately, and thus the stamps of mail flown across the Atlantic by Admiral Byrd, to South America by Colonel Lindbergh, and around the world by the Graf Zeppelin, are highly prized. Minor errors of design or lithography often increase stamp values.

BIBLIOGRAPHY.—A. B. Creeke, *Stamp Collecting, a Guide for Beginners*; J. N. Luff, *The General Issues of United States Stamps*; Scott Stamp & Coin Company Catalog.

PHILEMON (c. 361-263 B.C.), Greek writer of the New Attic Comedy, was born at Soli in Cilicia or at Syracuse about 361 B.C. He moved to Athens at an early age. At one time also he lived at Alexandria. He wrote voluminously but only fragments of his comedies are extant. He was a rival of Menander. Philemon lived to be nearly 100 years old, dying in 263 B.C.

PHILEMON. See BAUCIS AND PHILEMON.

PHILEMON, EPISTLE TO, in the New Testament, is traditionally ascribed to the Apostle Paul, and in substance is a plea for a runaway slave, Onesimus, who has fled from his master, Philemon. It consists of but 25 verses, and implies that it was written while Paul was a prisoner at Rome, which would date it about 63 A.D. Several modern scholars have called attention to a similar brief letter from Pliny to Sabinionus, concerning a fugitive slave, and they hold that the epistle to Philemon merely Christianizes the same story, which would date the epistle about 125. Whatever its origin, the letter is a beautiful and instructive work.

PHILIKÉ HETAIREIA, a secret society, which was founded by expatriated Greeks during the period of post-Napoleonic reaction and, through its revolutionary agitation, precipitated the outbreak of the GREEK WAR OF INDEPENDENCE. Imbued with the conviction that the independence of Greece could only be achieved through the efforts of the Greek people, the leaders of *Philiké* undertook to convert the nation to their gospel of immediate action. Yet, in order to win over the hesitant and the timorous, they sedulously spread the myth of Russian assistance in the forthcoming struggle and offered the leadership of the Society to Count John Capodistria, the Greek adviser of Tsar Alexander I. Rejected in that quarter, their offer was eagerly accepted by Alexander Ypsilanti, a Greek member of the Tsar's military household, who was thereby placed in supreme command of the Revolution. The disastrous failure of Ypsilanti's campaign in the Danubian principalities and the consequent confinement of the insurrection to

Greece proper sounded the knell of *Philiké*. Its fate was sealed when its emblem, which had served as the national flag, was discarded by the National Assembly of Epidaurous, 1822, in the hope of placating the reactionary governments of Europe, who regarded *Philiké* with suspicion, because of its apparent affinity with the Carbonari and other subversive groups. Thus, though the most potent agent in launching the Greek War of Independence, *Philiké* took practically no part in its prosecution or in the organization of the new state.

PHILIP, ST., one of the twelve disciples of Jesus, mentioned as the fifth in all the four lists preserved of that band. He is said to have belonged to "Bethsaida, the city of Andrew and Peter," but did not become a disciple until he joined Jesus at Bethany. In the *ACTS OF THE APOSTLES*, he is mentioned as one of those who witnessed the election of Matthias to the place left vacant by Judas Iscariot; but no further mention is made of him later in the New Testament. From the days of the earliest writers of the Christian Church, he has continually been confused with Philip, the evangelist, a deacon of the 1st century, usually accounted one of the 70 earliest followers of Jesus, and who was chiefly known as the agent in the professed conversion of Simon Magus. The confusion, according to some scholars, may have started as early as the writing of the fourth Gospel, in which those not accepting the Johannine authorship, profess to see the character of Philip, the evangelist, underlying the portrait given there of Philip, the Apostle. Heracleon says that Philip died a natural death, but fails to say which Philip.

PHILIP IV, THE FAIR (1268-1314), King of France, 1285-1314, continued and developed the policy of his grandfather, Louis IX, making use of the expense of the feudal nobility. Noble and clerical rising middle class to increase the royal power at the advisers were replaced by bourgeois lawyers and the jurisdiction and powers of the royal courts were increased. Philip's attempt to annex Gascony brought on a futile war with Edward I of England, 1293-1303. Flanders was temporarily absorbed as punishment for adhering to Edward, but the Flemish burghers rebelled at Philip's financial exactions and defeated his feudal army at Courtrai in 1302. His endeavor to tax the clergy precipitated a conflict with Pope Boniface VIII, in the course of which he instigated a vain attempt to capture the pope and take him to France. To rally French national sentiment against Boniface Philip summoned the first Estates General in 1302. His papal policy bore fruit in the election of Clement V in 1305, a Frenchman who took up his residence at Avignon and thus inaugurated the "Babylonish Captivity" of the papacy. By exerting pressure on Clement Philip brought about the dissolution of the Templar Order; their property was entrusted to him pending its transfer to the Knights Hospitallers. W. I. B.

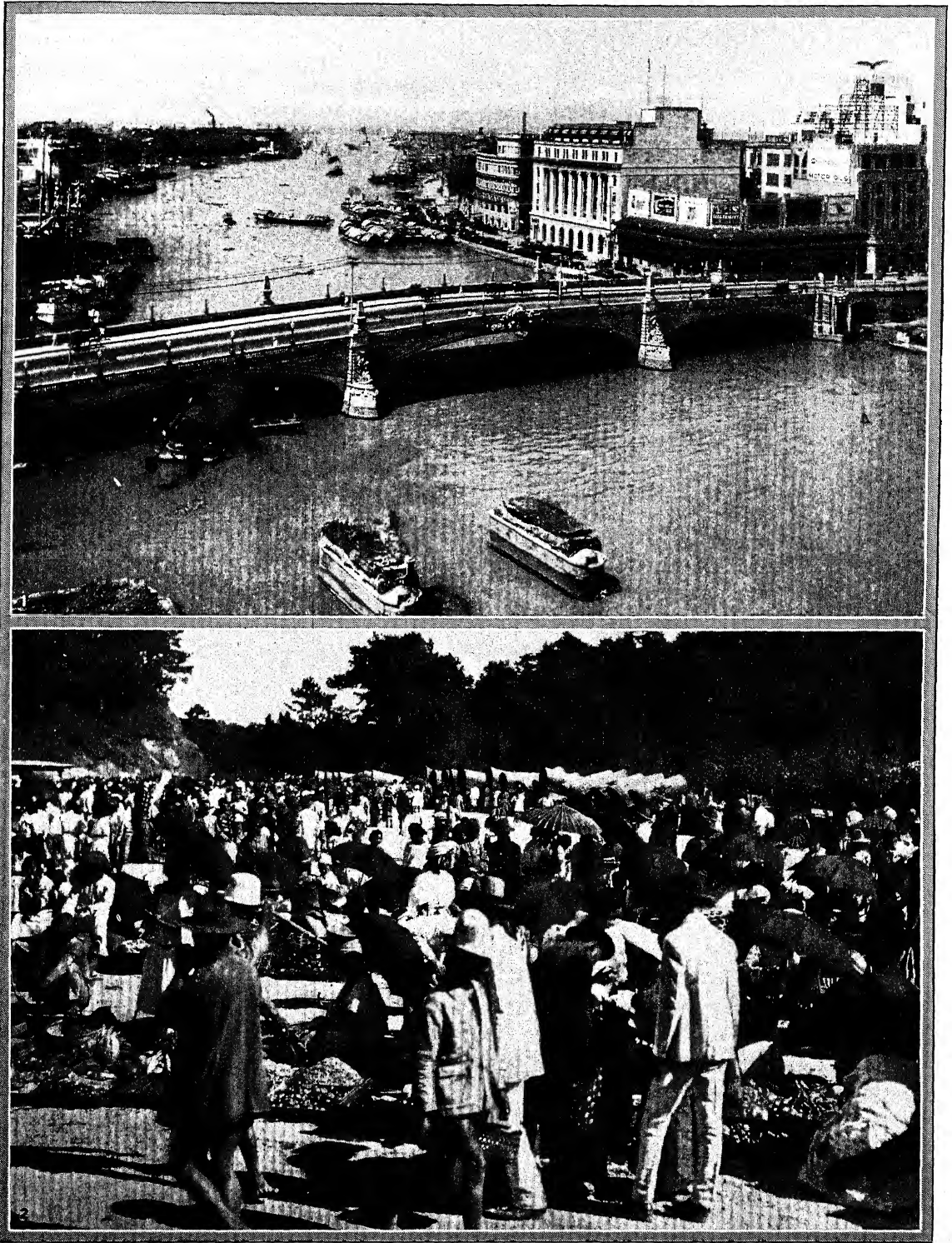
PHILIP, the name of five kings of Spain. **PHILIP I** (1478-1506), son of the Emperor Maximilian I and husband of Joanna, the daughter of FERDINAND AND

ISABELLA, assumed the title of king of Castille against the wishes of Ferdinand. Sailing to Castille, he died, soon after his arrival, in 1506. **PHILIP II** (1527-98). **PHILIP III** (1578-1621), son of Philip II, ended the war with the Netherlands, but began the rapid decline of Spain by driving out the Moriscos in 1609-10 and left the finances in hopeless confusion. **PHILIP IV** (1605-65), son of Philip III, through his advisor Olivares stimulated trade and industry, but engaged in wars in Germany and with France which weakened the country. In 1640 Portugal declared its independence, and in 1648 by the *TREATY OF WESTPHALIA* Spain granted independence to the Netherlands. **PHILIP V** (1683-1746), Duke of Anjou, the first of the Spanish Bourbons, was placed upon the throne by Louis XIV of France in 1700, but made good his claim to kingship only in 1713, when the *TREATY OF UTRECHT* ended the *WAR OF THE SPANISH SUCCESSION*. By the same treaty Spain lost the Italian territories and the Netherlands. In 1724 he abdicated in favor of his son, Louis, but the son died, and Philip remounted the throne. His son, Don Carlos, regained the two Sicilies in 1734-35. In the *WAR OF THE AUSTRIAN SUCCESSION* he was allied with *LOUIS XIV* of France against Austria.

PHILIP II (1527-98), King of Spain, was born at Valladolid on May 21, 1527, only son of the Emperor Charles V and Isabella of Portugal. He was educated by ecclesiastics, and developed no qualities which would qualify him for election to the position of Holy Roman Emperor. In 1543 he married Maria of Portugal. At her death in 1545 he went to Germany, where he lived for three years. In 1554 he married Mary of England. He became governor of the Netherlands in 1555, and was crowned king of Spain in 1556. From the outset his policy was "world-wide power for Spain and the Roman Catholic Church." In the pursuit of this policy he was successful against an alliance of France and the Papacy, but unsuccessful in his attempt to put down through the Duke of Alba the revolt of the Netherlands, spending enormous sums of money and losing the seven northern provinces. In 1559 he married Elizabeth, daughter of Henry II of France, who died in 1568, and in 1570 Anne of Austria. In 1579-81 he conquered Portugal. To defeat the English, he sent his Armada against them in 1588. From the defeat of this great fleet by Sir Francis Drake Spain never recovered. By Maria of Portugal Philip had a son, the famous *DON CARLOS*, and by Anne of Austria another son, Philip, who became Philip III (*see PHILIP*). Philip II died near Madrid on Sept. 13, 1598.

PHILIP, KING (1639-76), Indian chief, was born in 1639. He was the son of Massasoit, whose two sons the colonists named Alexander and Philip. In 1671, following considerable ill-feeling, he appeared before the General Court in Plymouth to present his case. Peace was agreed upon but violence between the Indians and the colonists soon recommenced, ending in the massacre of the English on June 24, 1675. A general uprising of Indian tribes now began, but

PHILIPPINE ISLANDS



1. EWING GALLOWAY PHOTO; 2. JOHN EDWIN HOGG PHOTO, FROM ORIENT AND OCCIDENT

ENGINEERING DEVELOPMENT AND A NATIVE MARKET IN THE PHILIPPINE ISLANDS

1. Jones Bridge over the Pasig River, the main vehicular bridge between the business section and the residential suburbs of Manila. Juana Luna Street is seen along the water front. 2. Market day at Baguio on the Island of Luzon. The town is a summer resort north of Manila.

the colonists gradually obtained the upper hand. Philip, besieged by the colonists, was killed by one of his own tribesmen on Aug. 12, 1676 while attempting to escape.

PHILIP OF MACEDON (382-336 B.C.), King of Macedonia and father of **ALEXANDER THE GREAT**, was born in 382 B.C. As Philip II he succeeded his brother to the throne in 359, and began enlarging his kingdom by seizing colonies under the protection of Athens. He led numerous expeditions throughout Greece, founded Philippi, and in 347 captured Olynthus. Within the next ten years an alliance composed of Athens, Thebes and smaller states was formed against him, but was crushed by Philip at the Battle of Chaeronea, 338. The king was now in control of Greece, and began the organization of a united force against Persia. While thus engaged he was assassinated at Aegae in 336.

PHILIPPI, an ancient city of Macedonia on Mt. Pangaeus, the Gangites River and on the road from Neapolis to Thessalonica. Philip II of Macedon founded Philippi on the site of the ancient town of Crenides; nearby were valuable gold mines. It was the scene of the victory of Octavius and Antony over Brutus and Cassius in 42 B.C. At this time Philippi became a Roman municipium. It was here in 53 A.D. that St. Paul first preached the Gospel in Europe, and it was to the Philippians that he addressed one of his Epistles. See also **PHILIPPIANS, EPISTLE TO**.

PHILIPPI, BATTLE OF, 42 B.C., a battle fought near the town of Philippi in Macedonia, during the Rebellion of Brutus. The Republican army of Brutus and Cassius, numbering over 100,000, contended with the forces of the triumvirs Mark Antony and Octavius (later Augustus Caesar). Brutus was successful in driving back the legions of Octavius; but Cassius was totally defeated by Antony. The arrival of reinforcements from the victorious troops of Brutus stemmed the retreat somewhat, though Cassius considered everything lost and committed suicide. On the following day, Brutus renewed the battle and this time was completely routed by Octavius. He, too, committed suicide.

PHILIPPIANS, EPISTLE TO THE, in the New Testament, is usually supposed to have been written by the Apostle Paul, while he was imprisoned in Rome, to certain Christians in Philippi, of whom we know nothing to-day. It opens as from "Paul and Timothy," but is written, nevertheless, in the first person. Because of its apparently exaggerated praise of the Philippians and Paul's praise of himself in the third chapter, some scholars believe that the epistle was written later, dating it between 125 and 140. The letter is devoted largely to the author's appeals for mutual love, and for the cherishing of "whatsoever things are true, whatsoever things are honorable."

PHILIPPIC, an oration of a denunciatory character. The term is derived from Demosthenes' invectives against Philip of Macedon, the father of Alexander the Great. To Demosthenes Philip represented

the rising power of Macedonia, and hence seemed a menace to the Greek commonwealths. In three famous orations he poured forth bitter personal attacks against this symbol of threatening power. Cicero's attacks on Antony are also known as Philippics; in fact the term has been extended to include any speech of a personal nature that is deeply invective in character.

PHILIPPINE INSURRECTION, 1899-1902, the uprising of native Filipinos against the extension of American sovereignty over the islands. The insurrection was a continuation of the nationalist movement against the domination of the Spanish friars. The Filipinos declared their independence of Spain on June 12, 1898, and on Jan. 23, 1899, established a republican government with a written constitution; Emilio Aguinaldo was elected president. The Philippine desideratum was the protection of the United States in the relations of the islands with other powers, but autonomy in local affairs. The occupation of Manila by the United States military promoted distrust of American intentions. On the night of Feb. 4 soldiers of the First Nebraska infantry fired upon a few insurgents, and during the next few days the fight became general. By Sept. 1899 the American army in the Philippines had been increased from 21,000 men to 31,000, with Gen. Otis retaining command, and Generals Lawton, MacArthur, Young, Bates and Bell commanding divisions dispatched into the interior of Luzon and to other islands in the archipelago to suppress the insurrection. By May 1900 these movements were successfully completed, and American troops were stationed in over 400 different posts. The losses during the eight months' active campaigning were about 1,400 men; the army's strength had been increased to 60,000. The Philippine army, having suffered heavy losses, was disbanded; the insurrection was readjusted to the mode of **GUERRILLA WARFARE**. The American troops adopted similar tactics and, exhibiting ruthlessness and brutality sufficient to invoke a Senatorial investigation, between May 5, 1900, and June 30, 1901, engaged in 1,026 contacts with the insurrectionaries, capturing 30,000, wounding 1,200, and killing 4,000. The American casualties during this period were 735; in addition 140 were captured or missing. In Feb. 1901 Gen. Funston discovered Aguinaldo's hiding place and captured the leader of the insurrection by a ruse. By Apr. 1902 the last of the native leaders was captured.

PHILIPPINE ISLANDS, a dependency of the United States consisting of 7,083 islands in the Malay Archipelago, 500 mi. southeast of China and 6,878 miles southwest of San Francisco. They are bounded on the north and east by the Pacific Ocean, on the south by Celebes Sea, on the west by the South China Sea. From north to south they extend about 1,152 mi., from east to west, 682 mi. The total land area of the group is 114,400 sq. mi., of which 70% is contained in Luzon, 40,814 sq. mi., and Mindanao, 36,906 sq. mi. The nine next largest are: Samar,

5,124 sq. mi.; Negros, 4,903; Palawan, 4,500; Panay, 4,448; Mindoro, 3,794; Leyte, 2,799; Cebu, 1,695; Bohol, 1,534; Masbate, 1,255. The remainder are all less than 1,000 sq. mi. each and 6,617 are less than 1 sq. mi. each. Only 2,441 have names.

Surface Features and Soil. A conspicuous feature of the islands is the 11,444 miles of coast line which exceeds that of the entire United States; the extensive mountain system which is largely volcanic in origin. There is little level surface except for the highland plateau in the central part of north Luzon. The mountain ranges run generally parallel from north to south and are of two types, those due to uplift and those due to volcanic action. Mt. Apo in southern Mindanao, 9,610 ft., is the highest point in the islands. The outstanding chain is the Cordillera Central in Luzon.

The Philippines form part of the "circle of fire" which follows the periphery of the Pacific Ocean, to which they contribute twelve volcanoes more or less active or solfataric. Mayon in southeastern Luzon, a remarkably symmetrical cone, 7,916 ft. high, erupted a 300-ft. stream of lava in 1928; Taal, 984 ft., which forms an island in Bombon Lake, Luzon, caused considerable destruction in 1911. Calaon and Banajao were active within the last century.

The archipelago, however, is not dominantly volcanic, but the worn-down edge of the Asiatic land mass. The land areas are merely the higher portions of a partly submerged mountain mass, with volcanic intrusives and extrusives of different periods. In its varied structure practically all the principal rock types are found. On a basement of igneous rock there are thousands of feet of sediment with outcrops of Mesozoic rocks which in turn are succeeded by lavas of the andesitic type with great accumulations of more recent tuffs, and considerable areas of coral limestone. The mountains are stored with minerals in unknown quantities. They include lignite, silver, copper and iron ores, asbestos, salt, sulphur, gypsum, petroleum and building stones. Considerable gold is found in placer deposits and the output of this metal is increasing.

Climate and Rainfall. The mean annual temperature for the islands is 80° F., with extremes of 100° and 60° F. May and June are the warmest months and Jan. the coolest. At Manila the mean Jan. temperature is 77° and June 82° F. The humidity at this point averages 80° F.

The average annual rainfall is 94.6 in. but it varies from 40 in. to 120 in. in different locations due to air currents. At Manila it is 75.43 in. From the first of November to the last of June the northeast trade wind prevails and the eastern coasts receive a heavy precipitation while the interior and western coasts are dry. Beginning with July and extending through October while the southwest monsoon prevails there is a rainy season throughout except for the eastern coasts.

In the larger islands there are extensive drainage systems. The chief rivers in Luzon are the Agno,

Pampanga, Pasig, and the Rio Grande de Cagayan which is 220 mi. long and drains over one-fourth of the island. In Mindanao the most important stream is the Rio Grande de Mindanao, 330 mi. long, the largest of the archipelago. The rivers flow generally north. There are also a considerable number of lakes of various origins, including Laguna de Bay and Bombon in Luzon and Buluan, Leguasan and Lanao in Mindanao.

The islands are subject to occasional earthquakes and are in the path of the typhoons which originate near Guam and sweep across the northern Philippines.

Vegetation and Animal Life. About 80,000 sq. mi. of the land area of the islands are forests having a great variety of trees. Some 53.7% of the total land area in 1926 was covered with commercial forests and 9.8% with non-commercial forest. In addition there are thousands of species of flowering plants and ferns and many species of orchids. The species of native flora are allied to those of Borneo and Celebes. There are more than 700 species of commercially useful trees, including dyewoods, timber for shipbuilding, wild rubber and gutta percha, cedar and ebony. The bamboo and coconut palm grow in all the islands, and the banyan which attains an immense size is common. Rattans, nuts, resins, gums, spices and valuable cabinet woods are among the minor forest products. The most valuable native plant is the wild plantain from which is manufactured abacá, or Manila hemp, greatly in demand for marine cordage. The flora is essentially Malaysian, its chief alliance being with that of the Malay Peninsula. The important cultivated plants introduced into the islands are rice, sugar, tobacco, coffee, cacao, maize and sweet potatoes.

The indigenous fauna includes few mammals but abounds in birds, reptiles and marine life. Among the mammals are the timarau, deer, wild hog, monkey, civet cat and at least 56 species of bats. Also the carabao or water buffalo which is used as a beast of burden. There are about 700 species of birds, mostly of the bright-hued, tropical varieties, including parrots, parrakeets, cockatoos, firebirds and sunbirds as well as jungle fowl, wild pigeons, snipe and plovers and mound-turkeys.

Crocodiles are common as are pythons and venomous snakes. Flying lizards, geckos, iguanas and turtles exist in the larger islands. Bees, butterflies, numerous species of ants, and mosquitoes abound and there are intermittent plagues of locusts. Oysters are caught for their shell and pearls. Edible bird's nests and the fins of the shark and ray are prepared for the Chinese market. Terrestrial and marine molluscs and coral beds are numerous.

Domestic animals have long since been introduced into the islands. In 1928 they numbered 1,220,000 cattle; 1,950,000 domesticated carabaos; 10,300,000 swine; 410,000 sheep; 1,415,000 goats; 325,000 horses and mules.

Agriculture. Agriculture is the main support of the population although in 1926 only 12.5% of the

total land area was under cultivation; grass and open land totalled 18.9% and unexplored land 4.2%. The average farm is six acres. For the same year the agricultural laborers numbered 2,601,229. In 1929 the cultivated area was 9,900,000 acres, the grass and open land 13,100,000 acres, and the forest land 46,500,000 acres, of which the government owned 98%. There were 34,580,000 acres of idle land suitable for cultivation.

In 1929 the acreage and production of the chief crops were: rice, 4,387,000 acres, 68,152,000 bu.; corn, 1,273,000 acres, 13,994,000 bu.; Manila hemp, 1,198,000 acres, 469,465,000 lbs.; tobacco, 204,000 acres, 100,133,000 lbs.; coconuts (1928) 1,274,000 acres, 1,906,804,000 coconuts; coffee, 3,000 acres, 2,863,000 lbs.; cacao, 4,000 acres, 2,675,000 lbs.; sugar 637,000 acres of cane, 1,695,000,000 lbs. of raw sugar. Products of secondary importance were rubber, tea, citrus fruits, quinine and camphor.

Manufactures. The principal manufactures of the islands with the 1929 output were: copra, 1,066,000,000 lbs. (for the year ended June 30); coconut oil, 434,000,000 lbs.; cigarettes, 4,427,000,000; cigars, 295,000,000; cut timber, 754,000,000 board ft.; split rattan, 5,589,000,000 lbs.; unsplit rattan, 19,416,000 linear ft. In the same year 139,000 troy oz. of gold were mined as against 92,000 in 1928.

Various household industries are carried on, the principal ones being weaving of textiles, baskets and matting, and the making of hats and embroideries.

Trade and Transportation. The total foreign trade for 1929 amounted to \$311,607,500, of which \$164,477,000 represented exports and \$147,160,500 imports, making the trade balance favorable by \$17,287,000. Of exports, 76% went to the United States; of imports, 63.4% were from the United States.

Exports by products and value were sugar, 695,868 metric tons, \$53,245,000; Manila hemp, 189,400 metric tons, \$28,421,000; copra, 173,570 tons, \$15,566,000; coconut oil, 190,520 tons, \$29,185,000; copra meal, 113,790 tons, \$3,793,000; desiccated coconut, 22,285 tons, \$3,540,000; leaf tobacco, 60,801,000 lbs., \$4,392,000; cigars, 188,333,000, \$3,825,000; lumber, 104,697,000 board ft., \$3,619,000; maguey fiber, 15,785 tons, \$1,630,000; hats, 950,741, \$2,049,000; embroideries, \$5,765,000; gold ore, bullion and coin, \$3,500,000.

The principal imports with values were: cotton manufactures, \$26,977,000; iron and steel products, \$12,830,000; petroleum products, \$9,785,000; vehicles, \$7,362,000; rice, \$5,310,000; wheat flour, \$5,060,000.

In 1929 Philippine foreign trade reached its highest peak, having increased 18% over 1928. In 1930 the amount was \$256,260,082, a decrease of \$55,337,036 or 18%. Exports amounted to \$133,167,128 and imports, \$123,092,954. Two-thirds of the loss in exports was due to the reduced shipment of coconut oil and Manila hemp.

The number of vessels in foreign trade entering Philippine ports in 1929 was 1,510 carrying 5,617,000

net registered tons. Entrances at Manila were 4,190,000 tons; at Iloilo, 376,000 tons; at Cebu, 773,000 tons. Vessels in coastwise trade in 1928 numbered 1,461.

In 1929 the islands had 671 mi. of railroad in operation which carried 2,170,000 tons of freight. The highways in 1929 totalled 7,854 mi. of which 4,200 mi. were first class. That year \$7,840,000 was spent on roads and bridges. There were 58 radio stations including one communicating directly with the United States, opened at Manila Dec. 1, 1930.

Finance. The government revenues from ordinary sources in 1929 amounted to \$43,635,288 and the ordinary expenditures \$39,416,919. The chief sources of income are the excise tax, license and business tax, income tax and import duties. The islands are exempt from Federal taxation and receive the benefit of their customs duties and internal revenue. The principal expenditures were for debt service, public health, education, agriculture and to aid local governments. One-third of the appropriation for public health was used for the segregation and treatment of lepers for which there is a large station at Cebu.

The net bonded indebtedness was increased by \$700,000 in 1929, totaling \$88,318,500. The unit of currency is the peso with a par value of \$.50 in United States currency.

Education. The school system is administered by a secretary of public instruction who heads the government bureau of education. Since the establishment of public schools in 1901, marked progress has been made in education. Normal schools have been established to train native Filipino teachers, and special attention is given to health and vocational training. There are numerous schools for industrial education, giving instruction in domestic science, commerce and needlework and other handicrafts. In 1928 there were 309 schools of agriculture with an enrollment of 27,133.

In 1929 the enrollment in the public schools was 1,161,367, an increase of 50,000 over the preceding year; in private schools, 93,618; and in the University of the Philippines at Manila, 7,753. About 98% of the teachers are Filipinos. Expenditures for education in 1929 amounted to 21% of all government expenditures, yet the schools were able to provide for only about 40% of the total school population of 3,179,570. Illiteracy is estimated at between 50 and 60%.

Among the institutions of higher learning are the University of Santo Tomas, founded in 1611, the oldest university under the American flag, the state-controlled University of the Philippines, and the National University and University of Manila, two privately owned institutions. *See also* PHILIPPINES, UNIVERSITY OF THE.

English is the language of instruction and is being used increasingly in daily life by the younger generation. The older lowland people speak mostly Spanish. In addition there are 68 dialects of which 26 have a printed literature.

Government. Civil government was established in the Philippines in 1902 and was first administered by a governor and a Philippine commission. This arrangement existed until 1916 when the Jones Act, passed by the United States Congress on Aug. 29 of that year provided that executive power be vested in a governor general appointed by the President of the United States, and legislative power in two houses, a senate of 24 members elected for six year terms, and a house of representatives of 91 members elected triennially, both by popular vote.

The vice governor general who is also the secretary of public instruction, the supreme court, and the insular auditor are also appointed by the President. There are six executive departments, education, commerce, interior, justice, finance, forestry and agriculture, the heads of which constitute an advisory Council of State presided over by the governor general. The majority floor leaders, the president of the senate and the speaker of the house also are members of this council.

The legislature elects two delegates, who have a voice but no vote, to represent the Philippines in the United States Congress. Since the establishment of civil government the Filipinos have been admitted in increasing numbers to civil service posts. On Dec. 31, 1928, there were 19,606 Filipinos connected with the government and 494 Americans.

For purposes of local government the islands are divided into 39 provinces each headed by an elected provincial governor, and further divided into municipalities headed by mayors. Local government is in the hands of the Filipinos. Suffrage is conferred upon men over 21 years of age who can read and write English, Spanish or a native tongue. The principal political parties are the Collectivista or Coalition party and the Democrats. In 1931 there were 1,200,000 registered voters.

The governor general may veto any bill passed by the Philippine Legislature. If it is passed over his veto, it must then go to the President of the United States for final decision. In Apr. 1927 President Coolidge vetoed an act of the Philippine Legislature calling for a plebiscite on independence.

Population. The population as estimated in 1930 was 12,204,100. The official 1918 census was 10,314,310 or 90 per sq. mi. Pop. 1903, 7,635,426. In 1918 the inhabitants were divided by color into brown, 9,386,826; yellow, 50,826; white, 12,399; Negro, 7,623; half-breed, 34,663; by religion into Christians, 90% and the remainder Mohammedans and pagan wild tribes living in the mountains. The dominant religion is Roman Catholic. According to the census of 1918, about 1,500,000 are members of an independent church organized in 1899 by Gregorio Aglipay, a Filipino and a former Roman Catholic priest.

There are as many as 43 ethnic groups which are divided into three general race types. 1. Pygmies which are subdivided into the Negrito, Proto-Malay and Australo-Ainu, all pagans. The original in-

habitants of the islands were Negritos of which about 25,000 remain. 2. Indonesians, also pagans, who are taller and have affinities with certain races of South Asia. Among these are the Igorots who live in the interior of Luzon and are famous for their terrace system of rice-growing. 3. Malays which are subdivided into pagan tribes, Mohammedans or Moros, and Christians or Filipinos. The latter group is by far the largest.

The population is increasing partly by immigrants of whom the majority are Japanese. The average number of immigrants per year during 1925-29 was 11,862; the average emigrants 1,134.

In 1918 there were seven cities with populations exceeding 40,000. MANILA, the capital and chief port, had 285,306; Cebu, 65,502; Legaspi, 52,756; Iloilo, 49,114; Lipa, 46,577; San Carlos, 42,453; and Bataugas, 41,089. In 1930 the population of Manila was estimated at 300,000, that of Cebu, at 86,152; of Iloilo at 67,143; Legaspi, 33,048; Laoag, 40,879; and Zamboanga on Mindanao, at 47,302.

HISTORY

MAGELLAN reached the Philippine archipelago in Mar. 1521. Miguel Lopez de Legazpi, sailing from Puerto de Navidad, New Spain, in Nov. 1564, reached Cebu in the following April, and planted there the first settlement. On account of the hostility of the Portuguese, who were, by the Treaty of Saragossa, 1529, between Spain and Portugal, entitled to the Philippines, his main forces were shortly removed to the island of Panay. Five Augustinian friars arrived with Legazpi; representatives of other religious orders followed, and converted the natives with comparative ease. By 1600 all the archipelago except Palawan and the islands occupied by the Sulus and Moros were under Spanish control. The motives of the conquest were religious rather than economic; even until the close of the Spanish rule exploitation of the island's resources was discouraged. The city of Manila was founded in June 1571 and made the administrative center. The colonial government was modeled after that in the Latin-American provinces; the ecclesiastical hierarchy included an archbishop at Manila, and three bishops. Chinese pirates, the untameable Moros, and Dutch expeditions harassed the Spanish posts. During the SEVEN YEARS' WAR a British expedition captured Manila, Oct. 5, 1762, but the conquered territory was restored to Spain by the Treaty of Paris in the following year. Charles III, who brought liberal innovations into Spanish policy, in 1785 chartered the Royal Philippine Company to conduct direct commerce between Luzon and the ports of Spain; the company ceased to exist in 1830. The Spanish policy toward foreign commerce with the Philippines was uncertain and vacillating. In 1814 foreign companies were permitted to establish houses in Manila, but in 1828 they were forbidden to sell at retail; other ports were opened in 1830, and all were closed in 1831. Manila was reopened in 1837. A government monopoly of tobacco, introduced in

1782, employed forced labor at fixed wages; despite the dangerous dissatisfaction it created, the system was not abolished until 1882. Another grievance of the natives was, in addition to the exaction of tribute, the *polos y servicios*—40 (later 15) days' labor in public works annually. Nationalist sentiment in the Philippines developed after the liberal Spanish constitution of 1812 was abrogated by Ferdinand VII, and in the latter part of the century was fostered by a "Young Filipino" party numbering José Rizal, Marcelo del Pilar, López Jaena and Apolinario Mabini among its leaders.

The insurrection of 1896 was an agrarian revolt, aimed primarily at the expulsion of the friars and the acquisition of the friary lands; it ended when Emilio Aguinaldo and other leaders were bribed to leave the islands. Aguinaldo returned to Manila shortly after Admiral Dewey had captured the city (*see* SPANISH-AMERICAN WAR). The Filipinos declared their independence of Spain on June 12, 1898; on Sept. 15 an assembly convened at Malolos, and on Nov. 29 adopted a constitution. The independent government, with Aguinaldo as president, became operative in January; but almost immediately difficulties with the United States troops at Manila brought about the so-called PHILIPPINE INSURRECTION. The United States established civil government under a commission of five Americans (headed by WILLIAM HOWARD TAFT) and three Filipinos; this administration was superseded on Oct. 16, 1907, when the first session of the Philippine legislature—the upper house equivalent to the old appointive commission, and the lower house controlled by the natives—began. English became the sole official language in 1931. James F. Smith was governor-general until May 1909 when President Taft appointed W. Cameron Forbes; Burton Harrison served from Oct. 1913, until the appointment of Gen. LEONARD WOOD in Oct. 1921; after Gen. Wood's death, HENRY L. STIMSON served as governor-general. Dwight W. Davis received the office in Mar. 1929 and served until Jan. 1932, when Theodore Roosevelt, Jr., was appointed by President Hoover as governor-general. The UNDERWOOD TARIFF ACT of 1913 extended complete free trade to the Philippines; the Jones Act, 1916, promised ultimate independence. Investigative commissions appointed in subsequent administrations reported adversely, however, as to the capacity of the Filipinos for complete independence. The Republican party leaders in the United States consistently discouraged the Filipinos' aspirations. Nationalist sentiment developed as the cultural state of the Filipinos was improved; the elective assembly has consistently voiced the desire of the natives for independence, and has, accordingly, often been at loggerheads with the governor-general. The government has encouraged the participation of the Filipinos in the civil service, however; the proportion of natives so engaged has ranged as high as 98% of the service. The government has taken an intensive interest in the economic development of the islands; it controls the Manila Railway Co., the Philip-

pine National Bank, and the coal, cement, iron and petroleum industries.

BIBLIOGRAPHY.—E H Blair and J H Robertson, *The Philippine Islands 1493-1898*, 1903-04, J S. Reyes, *Legislative History of America's Economic Policy toward the Philippines*, 1923, D S Hibbard, *Making a Nation the Changing Philippines*, 1926

PHILIPPINES, UNIVERSITY OF THE, at Manila, P.I., a coeducational institution, founded in 1908. Schools and colleges of Liberal Arts, Medicine, Law, Pharmacy, Veterinary Science, Education, Fine Arts and Agriculture have been established as parts of the university. The College of Agriculture is located at Los Barros, Laguna Province. The university had productive funds in 1931 amounting to 1,450,000 pesos. The library contained 21,000 volumes. In 1930 there was 5,698 students and a faculty of 550 headed by Pres. RAFAEL PALMA.

PHILIPPINE SCOUTS, a component part of the regular army of the United States. The Scouts are composed of natives of the Philippine Islands who enlist for service in the Islands. Their organizations conform to similar ones of the regular army and are assigned to the various arms of the service as CAVALRY, ARTILLERY and INFANTRY. In time of emergency they would be of great value for operations within the Philippine Islands due to their being acclimated to the tropics.

Certain citizens of the United States hold commissions in the Philippine Scouts. In 1931 all officers who were receiving appointments were obtained from citizens of the Philippine Islands. The pay of the enlisted men in all Scout organizations is a little less than one-half the pay of soldiers of corresponding grades in the regular army. S. J.

PHILIPPOPOLIS (Bulgarian *Ploudiv*), the capital of the Bulgarian district of the same name, situated on the Maritza River, which here becomes navigable. The old city, consisting mostly of frame houses, sprawls over hills, while the new sections have the stamp of modernity. The city has many mosques and churches, a museum, national library and good schools. There is an active trade in beer, spirits, textiles, leather and tobacco. Fruit, nuts, grapes, rice and grain are cultivated. Named after its invader, Philip II of Macedonia, the Thracian *Eumolpia* flourished at the time of the Roman emperors. In medieval times Philippopolis belonged mostly to the Byzantine or Bulgarian realms, since 1363 to Turkey. In 1879 it was the capital of the autonomous Province of East Roumelia, which was united with Bulgaria in 1885. An earthquake in 1928 partially demolished the city. Pop. 1931, 85,136.

PHILIP THE EVANGELIST (1st century A.D.), a deacon and early Christian preacher, usually counted among "the Seventy" earliest followers of Jesus. He labored as a missionary in Samaria after the death of Stephen, his fellow deacon, and is recorded as being the agent in the professed conversion of Simon Magus, the historical character of which incident is discounted by modern critics. He is also remembered for his conversation with the Ethiopian eunuch. He is not

to be confused with Philip the Disciple, as was frequently the case among the early Christian fathers. The story of his birth, life and death is not known, but many legends have sought to fill in the years with events otherwise unrecorded.

PHILIP THE GOOD (1396-1467), Duke of Burgundy, was the son of John the Fearless and Margaret of Bavaria. On the assassination of his father in 1419 he signed the *Treaty of Troyes* with England, recognizing Henry V as heir to the French throne. This alliance was weakened when the Duke of Gloucester attempted to seize Hainault; but Philip was mollified by the grant of Champagne. During his siege of Compiègne *Joan of Arc* was captured. On the death of the Duke of Brabant in 1431 he inherited the Low Countries. By the *Treaty of Arras* with Charles VII in 1436 he gained virtual independence for Burgundy. Ghent rebelled against him in 1448, but was given light punishment. To the fugitive dauphin, Louis, he granted an asylum and a pension. As King, Louis intrigued against Philip, who replied in kind. By his third wife, Isabella of Portugal, he had three sons, Charles alone surviving him. Philip was one of the richest princes in Europe. He kept a magnificent court, and encouraged commerce and the fine arts. In 1430 he founded the Order of the Golden Fleece. The benevolence of his government and the maintenance of domestic peace earned him the title of The Good. Philip died at Bruges on June 15, 1467.

W. I. B.

PHILISTINES, the natives of Philistia, in ancient times the land along the southern coast of Palestine. The Philistines often fought the Hebrews, and their five chief cities, Ashdod, Gaza, Ashkelon, Gath and Ekron, successfully resisted Israelite attacks. In the 8th century B.C. the country was conquered by the Assyrians and, four centuries later, became subject to *Alexander the Great*. Goliath and Delilah were natives of Philistia.

PHILLIPS, STEPHEN (1868-1915), English poet and dramatist, was born near Oxford, July 28, 1868. He was educated at Cambridge, and at 22 published his first poems in *Primavera*, a volume also containing poems by his cousin, Lawrence Binyon. Phillips joined F. R. Benson's dramatic company and remained with him six years. *Christ in Hades* appeared in 1896, and *Poems* in 1897. His first play, *Paolo and Francesca*, was produced by George Alexander in 1901. Beerbohm Tree gave elaborate productions of *Herod* in 1900; *Ulysses*, 1902, and *Nero*, 1906. Other works include *The Sin of David*, 1904; *Harold*, 1900; *Panama*, poems, 1915. Unlike most modern poetic dramas, Phillips's plays show a full understanding of stage values. The poet suffered in his later years from a natural reaction to the indiscriminate praise given his first plays. While editor of the *Poetic Review*, he died in Deal, Kent, Dec. 9, 1915.

PHILLIPS, WENDELL (1811-84), American orator and reformer, was born at Boston, Mass., Nov. 29, 1811. He was educated at Harvard, and studied

at Harvard Law School. In 1835 he saw *William Lloyd Garrison* dragged through Boston streets by a pro-slavery mob, and on Dec. 8, 1837 his famous Faneuil Hall speech made him a leader of the abolitionist forces. To this cause he gave himself with the utmost devotion. As an orator Phillips ranks very high; his wit, his skill in discomfiting an adversary and his easy yet finished speech have become traditional. His speeches, edited by James Redpath, are published in two volumes. After the Civil War he worked for various social causes, including woman suffrage and prison reform. He died at Boston, Feb. 2, 1884.

PHILLIPS ACADEMY, at Andover, Mass., a private secondary school for boys opened in 1778. It was the first chartered academy in New England. The academy was named for its founder, Samuel Phillips, who with his father Samuel, and his uncle, Dr. John Phillips, deeded land and money for the establishment of the institution. An archaeological department, founded by Mr. and Mrs. Robert S. Peabody, was added to the academy in 1901. In 1908 the academy added to its area the grounds formerly occupied by the Andover Theological Seminary, which moved to Cambridge. Its endowment is \$8,000,000. The library contains over 30,000 volumes, and the enrollment averages 600 students.

PHILLIPSBURG, a town of Warren Co., N.J., located on the east side of the Delaware River, 50 mi. north of Philadelphia and facing Easton, Pa. It has a site of varied topography rising from the flat river banks to hills attaining a height of more than 300 ft. Phillipsburg is an important railroad center being served by the Pennsylvania, Lehigh Valley, Lehigh and Hudson, Central of New Jersey and Lackawanna railroads; and here are located extensive railroad shops. Its varied industries, with an approximate value of \$31,000,000 in 1929, include the manufacture of silks, concrete products and agricultural and mining machinery. The retail trade in 1929 amounted to \$6,342,154. It was settled around 1750 and became important as the western terminus of the Morris and Essex Canal. It received its charter as a town in 1861. Pop. 1920, 16,923; 1930, 19,255.

PHILLIPS EXETER ACADEMY, at Exeter, N.H., one of the leading preparatory schools for boys in the United States. It was founded in 1781 by Dr. John Phillips, who also contributed to the foundation of *Phillips Academy* at Andover, Mass. Among the many men of prominence numbered in the academy's alumni are Daniel Webster, Louis Cass, Jared Sparks, John Parker Hale, Edward Everett, George Bancroft, and the sons of Lincoln, Grant and Cleveland. The academy has an endowment of \$470,000 for scholarships alone, and in addition to this sum, 25 tuition awards are made each year by the academy. A summer session was established in 1919. The enrollment averages about 750 students.

PHILLPOTTS, EDEN (1862-), British novelist, was born at Mt. Abou, India, Nov. 4, 1862. He was

educated at Plymouth, worked with an insurance company for ten years and then studied for the stage. In 1896 *Lyng Prophets* won popularity, as did also *Children of the Mist*. His scenes and characters depict Devonshire life with vivid and realistic faithfulness. Among other books are *The Good Red Earth*, *The Haven* and *Children of Men*.

PHILO JUDAEUS (c. 20 B.C.-40 A.D.), known also as Philo the Alexandrian, eminent Judeo-Greek philosopher and writer, was born about 20 B.C. He was the leader of the Jews of Alexandria, the greatest man and thinker ever produced by Alexandrian Jewry. Philo attempted to work out a philosophical system which might combine the finest and noblest doctrines of both the Jewish and the Greek teachers. Nothing is known of his life except that he made one journey to Palestine, spending some time in Jerusalem, and that in 40 A.D. he was head of a deputation of Alexandrian Jews who came to Rome to make complaint before Emperor Caligula regarding the attacks made on them by the Greeks of their city. He died shortly after 40 A.D.

Hellenic in education, Philo knew no Hebrew, and read the Bible only in Greek translation. He believed that the most profound human wisdom is contained in the Hebrew Scriptures, and he was an exponent of the allegorical interpretation of Scriptures.

As a philosopher Philo was an eclectic, deriving many of his ideas from Plato, the Stoics, and the popular ideas of his time. His works consist of a number of treatises dealing with metaphysics, ethics and psychology; also commentaries on portions of the Bible. Most of his works now extant, were preserved by the Church Fathers. The most important were: *Legum Allegoriae* or *The Allegories of the Law*, a work on Moses and his laws, including biographies of the patriarchs, Joseph and Moses ("Vita Mosis" or "The Life of Moses"), and treatises on the Decalogue, the special laws, the creation of the world and rewards and punishments; *Against Flaccus*; *Embassy to Gaius*, and *On Providence*.

Philo's influence on Judaism is slight, for the Jews of his own and later times refused to accept his teachings. However, early Christianity embraced him warmly, and many of the early Christians regarded him as a Christian.

A. SH.

See Graetz, *History of the Jews*, 1926.

PHILOMELA, in Greek mythology, daughter of Pandion, King of Athens. Tereus, King of Thrace, her sister Procne's husband, dishonored her and cut out her tongue so she could not betray him. She wove the story into some cloth, and the sisters in revenge slew Tereus's own son and served him up as a meal to his father. When he pursued them, the gods changed Philomela into a nightingale, Procne into a swallow and Tereus into a hawk.

PHILOSOPHER'S STONE, the object of search in ALCHEMY and other occult lore, which if found, would reveal the secrets of nature and confer extraordinary power, such as restoring youth, lengthen-

ing life, and converting baser metal into gold. According to some accounts it was a stone, such as the shew-stone of Dr. Dee preserved in the British Museum, which enabled its owner to see at a distance and foresee the future. The term became a general one for referring to the alchemists' or occultists' quest. See also CHEMISTRY: History.

PHILOSOPHY is exceedingly difficult to define on account of the very characteristic which most distinguishes it, i.e., its generality and comprehensiveness. While etymology is not always a significant guide to meanings, it gives perhaps what is still the best clue in the present case. The Greek word from which the English is derived means "love of wisdom." If we do not think of these terms too narrowly it would be hard to improve upon this phrase as a definition of philosophy. The word love would have to be interpreted in an active sense and not merely as an emotional attachment; thus we should think of philosophy as an energetic quest for wisdom and not simply as delight in it when attained. The word wisdom is particularly significant in that it embodies both the idea of expanded and organized knowledge and the intimation that this knowledge does not function as a speculative possession alone but also as a guide to life. Philosophy seeks the largest totality of thought by which man may orient himself in his world.

Relation to Sciences. The relation of philosophy to other intellectual enterprises may be outlined as a commentary on this definition. Its relation to science is peculiarly important. Originally they were one. Even in early modern times the physical sciences were spoken of as natural philosophy. But as the sciences succeeded in developing a technique of objective verification, so that within a certain range of human experience results could be established, demonstratively accounting for the facts and compelling subsequent thinkers to take them as a basis in further inquiries, they became separated from the parent stem of philosophy and entered upon an independent career. A century ago the chemical and biological sciences were following physics in attaining an independent position, and during the last half-century psychology and the social sciences have been struggling to secure an objective foundation permitting systematic growth in the same way. From this standpoint philosophy is the yet debatable area fringing the realm of science. Does this mean that with every advance in science the field of philosophy is narrowed, so that we may think of the perfecting of scientific knowledge as involving the extinction of philosophy? The history of thought reveals the contrary. For with every advance of science new philosophic questions arise challenging discussion, such as that of the significance of the scientific discovery in the light of other ranges of experience. That such questions are often discussed by scientists does not make them any the less philosophic in nature.

A further consideration is needed. Philosophy selects the more general of these unsettled questions to focus upon, and since it does so, at one point science and philosophy converge so completely that it is im-

possible to distinguish between them. When the scientist projects large-scale theories by which he hopes to organize vast masses of facts, such as the theory of evolution, he is engaging in philosophic speculation as well as performing a necessary scientific function. Such a theory is an idea of philosophy because it is so comprehensive that it cannot be verified as fully or certainly as the specific laws and relations which it includes; it is an idea of science because without it the scientific explanation as such is incomplete. Science is not satisfied with a group of particular laws lacking the unity and consistency which an embracing theory supplies.

Relation to Art and Religion. The generality of philosophic thinking is revealed also if we consider its relation to art. The production and enjoyment of beauty is of course not philosophy. But to inquire in a serious and systematic way what the nature of beauty is, how to tell as between different aesthetic scenes or works of art which is the more beautiful, and by what principles various aesthetic effects are produced—in short, to work out a theory of art is philosophy. Similarly in the case of philosophy's relation to practical affairs and religion. To choose between a career at law and one in business is not necessarily to philosophize. But to raise fundamental questions about what is good and bad, right and wrong, in human conduct, and to use the results of such reflections in guiding one's serious choices is to philosophize. To repeat a catechism is not a matter of philosophy, but to attempt in earnest to answer such questions as whether there exists the being whom men call God and what his relation to the world is plunges one at once into philosophy.

These illustrations amply reveal that philosophy deals with the broader, underlying questions that we see on reflection to be involved in every attempt to treat intellectually any phase of human experience. They are the questions to which most people take for granted some answer all the time and all people most of the time, but which it is evident must be answered satisfactorily if our thinking on other matters is to be sound. For this reason one who devotes himself to the study of philosophy is apt to acquire a more critical attitude than other people reveal, for he wants to be sure in dealing with any question that the underlying issues have been adequately faced, and also an attitude of tolerance and impartiality, derived from his realization that there is much to be said on both sides of even the most ubiquitous human beliefs. The popular conception of philosophy takes account of this element to some extent. To face an experience philosophically is to take it with sufficient impartiality not to expect more than it is capable of yielding and with readiness to make the most out of it under the circumstances.

MAIN BRANCHES OF PHILOSOPHY

Consideration of the relation of philosophy to science, art, religion and practical affairs, prepares the way for noting its major divisions. There is no universally accepted classification of philosophy, and there

are signs in contemporary speculation that a considerable realignment of the branches of philosophy may be in progress. A rather frequent classification, however, would distinguish three main branches, namely, METAPHYSICS, EPISTEMOLOGY, and THEORY OF VALUE.

Metaphysics is the attempt to define reality and to describe its most general aspects, *i.e.*, those which transcend the explanations of the several sciences. The discussion of the concepts to be used in defining reality is ontology, while the working out of a comprehensive picture of the world-process is cosmology. Philosophy of religion is a branch of metaphysics which involves both ontological and cosmological elements. Epistemology is the study of ultimate problems about knowledge, its nature, possibility, and the conditions of its validity. In its traditional form it has presupposed a metaphysical theory now increasingly questioned. When emancipated from that theory it tends in its main aspects to become merged either with metaphysics or with one sub-branch of the theory of value, logic. The theory of value is the examination of those ultimate questions which involve an element of comparative evaluation. A central problem in the theory of value is the determination of standards of goodness and badness, correctness and incorrectness. It subdivides into three main subordinate branches according to the type of value involved. Logic is that branch of the theory of value which attempts to formulate standards of correctness in thinking. Whether and why an argument is valid or not is a question of logic. Ethics is the branch which deals with standards of goodness or rightness in conduct, and other problems whose solution is involved in the determination of such standards. Aesthetics is the branch which discusses the problems clustering about the nature and norms of beauty.

It will be evident that philosophy touches science most closely in its branches of metaphysics and logic, the former beginning where scientific theories stop, while one function of the latter is the discussion and criticism of scientific method. In aesthetics it touches the world of art and contemplative enjoyment, in ethics the realm of concrete practical problems; while theology in religion is a metaphysical theory resting upon certain assumptions.

HISTORY OF PHILOSOPHY

To write a general history of philosophy in one treatment is impossible, because many nations with developed systems of philosophy have been so isolated from the currents of thought in other nations that the development runs in separate series without significant interaction. Thus until almost the present generation the philosophy of the Oriental nations has lacked contact with that of the western world, and indeed for long periods they have had little influence on each other. The nations of the East find it necessary, therefore, to write the history of their philosophy as essentially a part of intra-national cultural history. The nations of Europe, however, have for the most part been in sufficiently intimate relations with each

other so that the history of philosophy in the western world may be treated as a single development. For this reason, and because of lack of familiarity on the part of western writers with the details of intellectual development in the Orient, European and American authors of histories of philosophy have attempted to portray under that phrase the growth of philosophic ideas in occidental countries. It may be remarked parenthetically that one of the major defects of western philosophy at the present time is lack of the same eager interest in Oriental ideas that eastern students are beginning to show in western thought. Such provincialism is alien to the genius of philosophy.

In the West, philosophy is generally supposed to have started its career with the cosmological speculations of a group of men residing in the Greek colonies in Asia Minor, early in the 6th century B.C. This starting point is somewhat arbitrary, but is selected because these men were apparently the first to think about explaining the world in definitely naturalistic as over against mythological terms. By this is meant that instead of appealing to fanciful and imaginative tales involving the activities of beings not present in ordinary experience they couched their explanations in terms of common objects and every-day processes. Thus THALES thought of water as the underlying substance out of which all things are formed, and ANAXIMENES supposed it more probable that air fills this function.

Socrates, Plato and Aristotle. As will be evident from these illustrations, the aim of these earliest cosmologists was to find some one substance out of which the universe could be plausibly regarded as built. In the main, this interest characterized the development of Greek philosophy down to the time of SOCRATES. Further reflection, of course, quickly made the defects of these crude guesses evident, and some of Thales's successors found it necessary to appeal to a plurality of substances to explain the world, while others brought in laws of change or moving forces in addition to the substances as principles of explanation. The high-water mark of this cosmological trend was reached in the work of the great atomist DEMOCRITUS who, developing suggestions offered by his predecessor Leucippus, conceived it possible to explain the qualitative diversity of the experienced world by regarding it as composed of minute atoms differing only in quantitative characteristics such as size and shape. These atoms, he held, are in eternal motion according to laws determined by the structure of the atoms, and thus complex bodies are formed and in time again destroyed. Such ideas later on furnished the groundwork of the successful development of the physical sciences.

At the time of Socrates moral and social problems had come to the foreground, due to the breakdown of traditional religious and legal controls. Thinkers were questioning whether there were any stable meanings of goodness in conduct and the more specific virtues, and whether any moral standards capable of commanding rational justification could be found.

Socrates believed in an affirmative answer to these questions, and spent his life in the endeavor to discover such meanings and standards. His method of doing this by showing up in argument the illogicalities of influential fellow-citizens brought him such disrepute that he was condemned to death by the Athenian assembly. His follower PLATO and the latter's own successor ARISTOTLE are generally regarded as the greatest geniuses of Greek philosophy. Plato's main significance lay in the fact that in carrying forward his master's program he discovered, as he thought, that the ultimate ethical and aesthetic meanings reached in clarifying the foundations of conduct, such as goodness, beauty and truth, furnished a more adequate key than those suggested by the cosmologists to the metaphysical problem. He conceived a realm of eternal Ideas or Forms, of which the three above mentioned were highest, affirming that this realm alone is truly real and communicates to the world of ordinary experience what degree of reality the latter possesses. In this consists the IDEALISM for which Plato is famous, although in his later dialogues a somewhat different metaphysical approach is evident, more akin to that of Aristotle.

Aristotle was thoroughly versed in the biological and medical knowledge available in his day, and his cosmology clearly reveals a biological point of view. In metaphysics he was the systematic founder of ontology, the attempt to determine the categories universally present in existence. In logic he was also a pioneer and systematic formulator, laying the foundations of logical analysis and expressing the rules of correct argumentation which were handed down to late modern times without extensive modification. In ethics the guiding principle of the control of reason over the passions, expressed in Plato's great dialogue *The Republic*, was used by Aristotle as the key to a systematic discussion of the virtues and their function in securing human well-being. His intellectual power and fertility have hardly been surpassed in western thought, since he developed the foundations of many new branches of knowledge while organizing and carrying constructively forward all those which already existed.

Decline of Greek Philosophy. After Aristotle Greek philosophy was in general on the decline. We may mention four groups including between them most of the philosophers of that period whose names have come down to us. Two schools whose emphasis was placed chiefly on the ethical problem were the Stoics and the Epicureans. (See EPICUREANISM.) The former found a satisfying way of life in following the rational order of Nature and maintaining self-control in face of all vicissitudes of fortune, while the latter conceived the good life in terms of an equable balance of pleasures, stressing those obtainable through the cherishing of friendships and the pursuit of wisdom. A school mainly interested in the problem of knowledge and puzzled by the difficulty of establishing a standard of objective truth was that of the Sceptics (see SCEPTICISM), whose leaders carried on a

lengthy controversy with the Stoic logicians. Influential in the latest period of Greek philosophy before its schools were suppressed by the Christian emperors were the Neoplatonists (*see* NEO-PLATONISM), who revised Plato's theory of ideas and made it into a mystical metaphysics and a religiously appealing cosmology.

The mediaeval period in western philosophy is especially difficult to characterize briefly. For about 500 years after the fall of Rome there was practically no constructive philosophic activity in Europe, though in the latter portion of these centuries Moslem thinkers across the Mediterranean and in Spain initiated a revival of speculation, in which the main ideas of Plato and Aristotle were studied and reinterpreted. In the 11th century Europe itself emerged sufficiently from intellectual childhood to take up seriously the great problems of thought. ST. ANSELM of Canterbury revived and developed more extensively Augustine's ontological argument for the existence of God, and attempted a systematic philosophic justification for the Christian doctrines of incarnation and atonement. This will reveal the spirit of the subsequent period of speculative activity. It was controlled by a dominant religious interest, and moved within the limits of established Christian doctrine. By the 13th century this movement had flowered in a widespread and vigorous intellectual revival. Plato and then Aristotle were drawn upon for guiding ideas, in large part through contacts with Arab speculators in Spain, and the foundations of Christian belief were worked over in harmony with the metaphysics and logic of the great Greek thinkers. This movement reached its culmination in the famous *Summa Theologica* of ST. THOMAS AQUINAS who treated systematically, on an Aristotelian basis, all human problems. Thomas's ' ' ' ' became officially accepted by the Roman Church, and is still to-day the framework in which its doctrines are set and by which their philosophic bearings are interpreted.

Bacon, Descartes, Spinoza and Leibnitz. During the 14th and 15th centuries European philosophy was a picture of great confusion, in which no clear tendency is easily discernible. The new inventions, explorations, religious movements, political changes, etc., were stimulating much ferment of ideas, but what sustained development was to emerge did not become evident till the early 16th century. By that time the new astronomy and mechanics, as championed by Galileo, were becoming sufficiently established in the minds of thinkers so that what they involved in the way of reconstructing traditional logical and metaphysical ideas offered the opportunity for a new philosophic development. The prophet of the human possibilities of the new sciences was FRANCIS BACON; but the man who first worked out an influential metaphysical system on the basis of modern mechanics was the French philosopher RENÉ DESCARTES (1596-1650).

Descartes noted that the essential feature of the new physical science was the reduction of the motion of

bodies to mathematical formulation and calculation. He was himself a pioneer in the mathematical sciences, being the inventor of analytic geometry, and in his early years toyed with the notion of working out a universal mathematics, which would be a method capable of reaching exact results in all soluble human problems. That it was possible always to run astray, however, even in a mathematical calculation, suggested that a deeper metaphysical system was needed to justify our confidence in mathematical analysis and also to indicate the field within which it may be properly applied. The attempt to solve this problem led him to seek some fact which transcended the possibility of any sceptical doubt, something which we could not possibly run astray in affirming. This he found in the thinking mind, whose reality was clearly involved even by a state of doubt itself. Such a consideration encouraged a dualistic separation between the realm of thought, describable by psychological categories, and the realm of mechanical motion, describable in geometrical terms. God's existence he thought demonstrable by the idea of a perfect being in our minds, while the veracity of God's nature guaranteed the truth of our mathematical reduction of the physical world. The realm of thought and the world of motion impinged on each other in the pineal gland of the human brain, where a nerve-motion is translated into an idea, and where a volition is translated into a muscular movement. BARUCH SPINOZA, a Portuguese Jew who settled in Holland, worked over these novel ideas of mechanical science and Cartesian (*see* CARTESIANISM) philosophy into a system which could be wedded to the profound quest for salvation characteristic of mediaeval thought. God, he held, is the unifying and substantial reality of the world, expressed in one aspect under the form of extension and motion, in another aspect under that of thought. Salvation is attained by intellectual union with God, which conquers and harmonizes the perturbations of emotion and brings such peace and blessedness as man's nature is able to attain.

GOTTFRIED LEIBNITZ, the other outstanding figure of this continental group, developed an original metaphysical scheme which almost defies any brief description. He conceived the world as a system of independent monads, whose inner essence is statable in terms of perception, but whose external relations with each other appear as the spatial world of physical science.

Locke, Berkeley and Hume. Among English thinkers metaphysical interest was not as deep as it was among continental speculators. JOHN LOCKE, a contemporary of Leibnitz, and his successors, GEORGE BERKELEY and DAVID HUME, are an interesting group who were forced into metaphysical considerations against their will. Locke was interested strongly in the practical problem of determining where and in what degree knowledge is attainable, so that scientific and philosophic inquiries might be guided in useful channels. The main result of his *Essay Con-*

cerning Human Understanding, 1690, was, however, to make all genuine knowledge seem impossible—that is, if one were to accept the prevailing Cartesian dualism and regard the mind as gaining access to the external world only through its own ideas which are essentially different from physical events. For two centuries thereafter the problem of knowledge became the crux of philosophic speculation. Berkeley tried to solve the difficulty by denying the material world outright. Knowledge, he held, is to be confined to our own sensations and their reproductions in memory and imagination, while the only reality that lies beyond finite minds and their immediate experiences is the infinite mind of God. Hume brought this line of thought to a sceptical outcome by noting that its implicit logic led not only to the denial of matter but also to the undermining of other metaphysical conceptions like that of a unitary soul and scientific assumptions like that of a necessary causal relation. These notions he held inevitable from the standpoint of practical life, which finds itself compelled to assume them, but unjustifiable rationally.

Kant and His Followers. This approach to metaphysical questions by way of puzzles about knowledge came in many respects to its climax in the philosophy of IMMANUEL KANT (1724-1804). Kant subjected knowledge to a systematic analysis, the general outcome of his analysis being that the mind contributes certain *a priori* forms to knowledge, such as are reflected in the forms of time and space and the categories of substance, causality and interaction, while the content understood in terms of these forms has an external origin. Accordingly wherever knowledge, as in the case of established physical science, makes proper use of these forms and categories, it is entirely valid; but wherever concepts are used which transcend the limits of these legitimate forms, as in the case of traditional theology and metaphysics, it is invalid. Thus scientific knowledge is justified by Kant's inquiry, while attempts to demonstrate God or the freedom and immortality of the soul are misplaced and futile. In his moral philosophy Kant found the foundations of good conduct in obedience to a rational law of duty which he thought necessarily implicit in men's moral judgments and universally binding on all rational beings. The great faiths of religion were reinstated by Kant in the form of moral postulates, *i.e.*, convictions which, though transcending knowledge, are none the less assumed in intelligent loyalty to the behests of the moral law. In a later work Kant dealt with the problems of aesthetics and peculiar difficulties arising from biological science.

Kant's successors in Germany used the general foundations of his system as the starting-point for the development of grandiose structures of idealistic metaphysic. In various ways they conceived an active thought or will as the primary factor in reality, capable of building its own world in accordance with its inherent demands. The most influential of these men was GEORG W. F. HEGEL (1770-1831), who at-

tempted to revise the traditional logic and make it a ladder of thought's development toward perfect comprehension of reality. Kant's forms and categories became rungs in this logical ladder, while the highest and culminating concept is that of the Absolute Idea, in terms of which the world is seen as an eternal rational process, satisfying both the urge for complete intellectual comprehension and the religious quest for spiritual value.

Comte, Bentham and Mill. In France and England speculative metaphysics was not as prominent in the first two-thirds of the 19th century as it was in Germany. In both these countries interest in ethical and social problems dominated the work of leading thinkers. The positivism of AUGUSTE COMTE reflects this situation in France; metaphysics he thought of as standing for a pre-scientific type of explanation which ought and is destined to be outgrown. The important matter for him was the building of a scientific sociology and its use in developing a more rational human civilization in which altruistic moral standards will control conduct and a religion of humanity, with its own appropriate cult, will replace the outworn religions of pre-scientific culture.

In England this ethico-social interest is best represented in the work of the Utilitarian (*see* UTILITARIANISM) school of thinkers. Of these JEREMY BENTHAM and JOHN STUART MILL were the most influential. Like the ancient Epicureans, the Utilitarians were Hedonists (*see* HEDONISM), that is, they conceived pleasure as the motivating force in human conduct and as the essence of moral good. As fulfilling the latter function, however, pleasure becomes the long-run happiness of the larger number of sentient creatures affected by an act, as opposed to the transient and private pleasure of the individual. This conception afforded a lever for effective criticism of customs and institutions whose constructive bearing on present human well-being was questionable. In John Stuart Mill this interest in intelligent control of social phenomena toward a utilitarian millennium led to a systematic examination of the foundations of scientific method in general in the light of the possibilities of social science in particular. He thus became the systematizer of modern inductive logic, as Aristotle was the systematizer of early deductive logic.

Darwin and Spencer. With the publication of Boole's *Analysis of the Laws of Thought* in 1854 and Darwin's (*see* DARWIN, CHARLES ROBERT) *Origin of Species* in 1859 two sciences begin a period of fruitful development destined to exert profound influence upon subsequent philosophy. Boole is the pioneer in the growth of modern mathematical logic, which has corrected and greatly expanded the traditional formal logic, throwing it into a form which has encouraged a new rationalistic realism, one of the influential movements in contemporary philosophy. Present-day realism takes varied forms in detail, but it is everywhere characterized by opposition to idealism, on grounds supplied by the new logic, and by a confidence that a correct analytic use of this

logical tool will lead to an exact and verifiable solution of many problems that had previously seemed to permit only speculative guesswork.

Darwin's theory of evolution, on the other hand, not only supported in main outline the comprehensive *Synthetic Philosophy* of HERBERT SPENCER, which had been projected before the *Origin of Species* appeared, but has supplied the main premises of PRAGMATISM, probably the most influential trend in American philosophy at the present time. By conceiving change as typically an advance from undifferentiated simplicity to an integrated complexity, it encouraged the idea that the universe itself was an unfinished process in which novelties of quality and behavior from time to time emerge. By showing the continuity of man with the lower animals it led to the conception of mind as a function of adjustment to environment similar in significance to the less pliable and efficient adjustments revealed in animal learning. This is the foundation of the pragmatic philosophy, which combines the above doctrine of mind and its relation to a world in flux with the idealistic assumption that mind is an active affair rather than a passive product of environing forces alone. WILLIAM JAMES defended pragmatism mainly in the form of a generalized method of approach to humanly interesting problems, while JOHN DEWEY has worked out detailed theories of logic and of ethics on the basis of this evolutionary conception of thought.

TRENDS OF CONTEMPORARY PHILOSOPHY

At the present time western philosophy is in a stage of active fermentation which promises extensive realignments of ideas but which makes prediction more than usually precarious. Many schools continue to thrash over old problems in terms of the old alternatives. On the other hand it is clear that the implications of the evolutionary viewpoint have not yet by any means been clearly realized in all their bearings, especially in respect of the relativity of scientific, moral and religious ideas to variable environing conditions that the conception of evolution involves. Moreover, the new discoveries of physical science, with the breakdown of Newtonian conceptions and the unrelenting attempt to develop new theories of the physical world, are stimulating philosophers to invent large-scale cosmologies in which these novel scientific ideas will be set in a comprehensive context. ALFRED N. WHITEHEAD is the American leader of this movement. But in following through both these directions of speculation philosophers are breaking down lines set up by traditional school differences, and even the points at issue in the debates a generation ago between idealists, pragmatists and realists (see REALISM) appear to have dropped into the background so much that it is hard to classify any contemporary thinker by means of the old rubrics. It is highly likely that philosophy is headed toward an era in which attention will be concentrated on issues only now vaguely emerging into significance

and in facing which new schools will be formed cutting across the traditional dividing lines of previous philosophy. A few age-long cleavages will perhaps remain, such as that between the rationalist and the practico-empiricist philosophic temper. It is to be hoped that fuller acquaintance with and appreciation of Oriental philosophy and the philosophies of outlying races will soon be a larger factor than it has been in developing western thought. E. A. B.

BIBLIOGRAPHY.—General Introductions to Philosophy: G. W. Cunningham, *Problems of Philosophy*, 1924; Will Durant, *The Story of Philosophy*, 1927; W. E. Hocking, *Types of Philosophy*, F. Larrabee, *What Philosophy Is*, G. T. Patrick, *Introduction to Philosophy*, 1924; F. Paulsen, *Introduction to Philosophy*, 1895; R. B. Perry, *The Approach to Philosophy*, 1905; Bertrand Russell, *Problems of Philosophy*, 1912. Standard Histories of Western Philosophy: G. Boas, *The Major Traditions of European Philosophy*, B. Erdmann, *History of Philosophy*, A. K. Rogers, *Student's History of Philosophy*, 1907; F. Thilly, *History of Philosophy*, 1914; F. Ueberweg, *History of Philosophy*, A. Weber and R. B. Perry, *History of Philosophy*, 1925; W. Windelband, *History of Philosophy*.

PHIPS or PHIPPS, SIR WILLIAM (1651-95), American colonial governor, was born at Woolwich, Me., on Feb. 2, 1651. For four years he was apprenticed to a ship's carpenter and later built his own ship and engaged in commerce. In 1687 he salvaged a wrecked Spanish treasure ship for the British government, and of the £300,000 he recovered, received £16,000 as his reward in addition to being knighted and appointed sheriff of New England. He went to England in 1690; by the recommendation of Increase Mather he was appointed the first royal governor of Massachusetts under the new charter of 1691. He died in London on Feb. 18, 1695.

PHLEBITIS, inflammation of a vein, associated usually with the formation of a blood clot within the vein but without pus formation. The veins most often involved are those of the left leg. The disorder may be due to injury to a vein, may follow an operation or some disease, such as typhoid fever, which causes loss of strength. It occurs often after childbirth. The cause sometimes cannot be determined.

The symptoms depend upon the location of the affected vein and the cause of the inflammation. There is usually pain of varying degree, starting suddenly and accompanied by fever from 99° to 101°F. If the vein is near the surface of the skin it may be felt as a firm cord, and there may be a red line on the skin. The symptoms may be slight when the phlebitis occurs in the course of an illness.

The acute symptoms usually subside within a week. In the treatment the patient must be put at rest. A narcotic may be required to relieve the pain. An ordinary light diet should be employed. When the temperature has been normal for three weeks and the tenderness has disappeared, massage may be employed. See also VARICOSE VEINS.

PHLEGETHON, in classical mythology, a river of fire surrounding the infernal regions and emptying into the Acheron.

PHLOGISTON THEORY. The overthrow of the old conception of elements by BOYLE (see also CHEM-

ISTRY: History of) eliminated fire as an element. The striking changes which take place during the universal phenomenon of combustion required a new explanation, which was supplied by the ill-conceived phlogiston theory. This attributed the ability to burn to the presence in combustible bodies of a component named phlogiston which escaped during the burning. Since metals gain in weight upon heating in air, it was postulated rather fantastically that phlogiston possessed "levity," or negative weight. Although most of the eighteenth century chemists were phlogistians, their important discoveries were made in spite of the theory, which was dealt its death-blow by the epoch-making work of LAVOISIER.

P. M. A.

BIBLIOGRAPHY—E. von Meyer, *History of Chemistry*.

PHLOX, the common and scientific name for a numerous genus of plants of the polemonium family, many of which are highly prized garden ornamentals. There are about 60 species, natives of north temperate regions. All except a single Siberian species occur in North America, chiefly in the United States. They are mostly low annual and perennial herbs, sometimes slightly woody, with opposite entire leaves and red, pink, blue or white salverform flowers in showy terminal clusters. Attractive species, some with unusually elegant flowers and foliage, grow wild in most sections of the United States. These have furnished some of the finest contributions from North American plants to modern floriculture and many flower lovers have urged the adoption of the phlox as the national floral emblem.

The annual flower-garden phloxes have been derived from *P. Drummondii*, a native of Texas, seeds of which were first sent to England in 1835. There are dwarf, compact and semi-double forms, occurring in a wide range of colors including white, buff, pink, purple and red. The common perennial phlox (*P. paniculata*), native to the southeastern states, has likewise been developed in numerous showy color varieties. Among the many other native phloxes widely cultivated are the SWEET WILLIAM (*P. divaricata*), the meadow phlox (*P. glaberrima*), and the moss pink (*P. subulata*).

PHOEBE, in Greek mythology, one of the names of ARTEMIS, goddess of the moon and the hunt.

PHOEBE (*Sayornis phoebe*), a small bird of the fly-catcher family common about dwellings in eastern North America. It is about 7 in. long, olive brown above and whitish below, tinged with brownish gray on the breast. Trustful and confiding in nature, it constructs its bulky, deeply cup-shaped nest of mud and moss about bridges, barns and other buildings, laying 4 to 6 white eggs. It feeds upon insects, which it captures by darting from a fixed perch in true fly-catcher fashion. The song of the phoebe is a monotonous repetition of the syllables "pewit phoebe." Two allied species occur in the western United States, the black phoebe (*S. nigricans*), with the plumage slate black above and white below, and Say's phoebe (*S. saya*), with the underparts light cinnamon or tawny.

PHOEBUS, in Greek mythology, one of the names of APOLLO, especially in his character as purifier from sin and defender from evil.

PHOENICIA. Although Phoenicia occupied only a narrow strip of coast a few miles in width, along the eastern Mediterranean, it held an important place in ancient history. Its central position at the crossroads of eastern and western trade was especially favorable for commerce, a factor fully exploited by its inhabitants. The Phoenicians, a Semitic people, were the most skillful sailors of antiquity, and from very early times their ships carried cargoes to all parts of the known world. They were never united into a single centralized government. Each city was ruled by its own king. Only in times of danger did they occasionally unite under the leadership of the most powerful among them. Tyre, Sidon, Berytus, Zarepta, Byblus and Aradus were the chief cities. Of these, Sidon appears to have been the most ancient.

Phoenicia first emerged into recorded history during the period of the 18th Egyptian Dynasty, when it was conquered first by the Pharaoh Ahmose I, about 1580-57 B.C., and later by Thotmes III, 1501-1447. For several centuries thereafter it remained under Egyptian domination, being forced to pay annual tribute. About 1300 B.C., while Egypt was being shaken by internal strife, the Phoenician cities seized the opportunity to throw off the yoke of their suzerain, and managed to maintain their independence until the 9th century B.C. During this comparatively long period of freedom, Phoenicia reached the height of its importance. Sidon, which had for some time exercised a sort of hegemony over the rest of the Phoenician towns, relinquished its powerful position to Tyre. The latter city became the greatest trading center of the Mediterranean. The principal towns, such as Tyre and Sidon, founded trading posts and colonies all along the Mediterranean Sea, and even on the Atlantic coast of Spain. The trading activities of the Phoenicians were of great historical value, bringing various civilizations in contact with one another. As manufacturers, these people also played a prominent part, perfecting the industrial arts to a high degree, and winning wide renown as artisans. It will be remembered that Hiram I of Tyre, about 970-936 B.C., supplied skilled workers and fine materials for the building of the palace and temple of Solomon at Jerusalem. Glassware, dye-stuffs, pottery and metalwork were the principal products of Phoenician industry.

In the 9th century B.C., Assyrian military expeditions reached Syria, and a large part of Phoenicia was subdued. The extent of the Assyrian domination of this country is not clearly known; but from 876 B.C. to the fall of Nineveh, 606 B.C., occasional payments of tribute by various Phoenician cities were recorded. Sporadic attempts of these cities to free themselves of Assyrian overlordship invariably ended in failure. With the fall of the Assyrian Empire, Phoenicia fell into the hands of the Egyptians, who held it but a short time before passing it on to the rising Chaldeans,

605 B.C. Sidon and other cities submitted to their new masters without resistance; but proud Tyre rose in defiance and for 13 years, 585-573, stubbornly withstood the siege of Nebuchadrezzar, a remarkable testimonial of her strength. When, in 538 B.C., the conquering Persians under Cyrus pushed their way into Phoenicia, Tyre once more boldly offered resistance. But this time the city fell before its attackers; thousands of her citizens were massacred, and thousands more were sold into slavery.

Under Persian rule, 538-333 B.C., Phoenicia experienced a great commercial revival, with Sidon again the leading city. The Persians permitted the towns a large degree of autonomy, and encouraged their seafaring activities. The Phoenician fleet became the main naval arm of the Persian Empire. After the power of Persia was broken by Alexander the Great, Phoenicia passed into Macedonian hands. In the division that took place after Alexander's death, it was won by the Syrian Seleucids. Pompey incorporated Phoenicia into the Roman province of Syria, 64 B.C., and thereafter it ceased to exist as a distinct country.

BIBLIOGRAPHY.—G. Contenau, *La civilisation phénicienne*, 1926; G. Rawlinson, *Story of Phœnicia*, 1889; *Cambridge Ancient History*, vol. 3, 1925

PHOENICIAN, a SEMITIC language of the CANAANITE group preserved in a number of inscriptions both from the mother country and from her colonies. The dialect is characterized by the accusative sign *ait*, the use of both *m* and *n* for the masculine plural of the noun, and the retention of the old Semitic *t* to denote the feminine. Phoenician gave rise to Punic and New-Punic; and several lines written in this language, given by Plautus in his *Poenulus*, are of value for a knowledge of Punic vocalization, and form the earliest attempt to represent a Semitic language in Roman characters.

BIBLIOGRAPHY.—P. Schroder, *Die phönizische Sprache*, 1869; G. A. Cooke, *Text-Book of North-Semitic Inscriptions*, 1903; I. Rosenberg, *Phönizische Sprachlehre und Epigraphik*, 1907.

PHOENICIAN ART. The chief characteristic of Phoenician art is its eclecticism, the result of borrowing freely from the arts of surrounding nations. It exhibits little originality, but rather a remarkable aptitude in combining foreign art motives. Their early art is derived mainly from Egypt, Babylonia and Assyria; in later times a Greek influence was added.

A practical people, whose sole object was material gain, the Phoenicians commercialized art as they did all else. But although they displayed a lamentable lack of artistic sense, they did distinguish themselves as craftsmen. Those branches of art which were merchantable they developed to a high degree of perfection. Frequent allusions made of their work in ancient writings stamp them as the most highly skilled artisans of antiquity. In the *Iliad* Homer writes of a silver wine-bowl that was "more beautiful than all others on earth, since it was wrought by those cunning workers, the Sidonians." A passage in the Bible tells of Solomon requesting Hiram of Tyre to send his renowned craftsmen to help build the great temple

Few examples of Phoenician architecture have been handed down to modern times. This scarcity is largely explained by the fact that, through the ages, building materials were carried away from the ruins of ancient structures to be used in new ones. Most of the known architectural remains of importance have been unearthed at Amrith. Here are several tombs, one of which prompted ERNEST RENAN to pronounce it "a masterpiece of proportion, elegance and majesty." This necropolis, 32 feet in height, rests upon a circular plinth flanked by four lions in high relief. Above the base rises a cylinder crowned by a hemisphere. Except for the plinth, which consists of four blocks, the whole is cut from a single huge stone. The tomb chamber, reached by a flight of steps, lies beneath the structure. In form this, as well as other sepulchral architecture of Phoenicia, shows unmistakable Egyptian elements. This influence is also found in temple architecture. The famous little cellatemple (El Maabed) at Amrith consists of three large blocks of stone, the whole resting upon a sub-structure about 16 feet high. The dominant feature is the cella or tabernacle, which contained an image of a god.

Sculpture also shows the imitative ability of the Phoenicians. The anthropoid sarcophagi found at Sidon, Byblos and other places are copies of Egyptian models, though the features of some of the later ones bear a Hellenic stamp. Reliefs cut in stone resemble those of Assyria but represent more peaceful pursuits. Statues of gods and goddesses are skillfully executed, being utterly devoid, however, of a sense of beauty.

The Phoenicians excelled in the industrial arts. Their metal vases and goblets were of the highest quality; their gold and silver dishes graced the table of many a foreign monarch. They were famous for their dyes and their glass manufacture, which they perfected but did not invent. In jewelry and in stone engraving they proved themselves efficient imitators, as usual.

BIBLIOGRAPHY.—G. Perrot and C. Chipiez, *History of Art in Phœnicia and its Dependencies*, 2 vols., 1885.

PHOENIX (gen. *Phœnicis*), the legendary Phenix-bird, a southern constellation with one bright star of the second magnitude and a number of fainter ones. It is visible in the southern portion of the United States during early evenings in November and December. See STAR: map.

PHOENIX, the capital of Arizona, the county seat of Maricopa Co., situated in the southern part of the state on the Salt River. The capitol is built of tufa rock, native to Arizona, and set in a park planted with beautiful trees and shrubs found in this section. Phoenix is a tourist center surrounded by many interesting natural phenomena, the Papago Saguaro National Monument and the city's mountain park among them; eucalyptus trees and the Saguaro cacti, prehistoric villages and cliff dwellings are near by. Phoenix lies in a saucer-like valley irrigated from the Roosevelt Dam and producing cotton, citrus, cantaloupe and other farm crops. The city has various manufac-

tures. In 1929 the factory output reached the approximate sum of \$13,000,000; the retail trade amounted to \$57,424,703; automobiles comprised the greatest sales. Sky Harbor airport adjoins the city, which has railroad connections with two lines. A state experimental farm and a state teachers college are not far away. Phoenix was founded in 1870, incorporated in 1881 and made the state capital in 1889. Pop. 1920, 29,053; 1930, 48,118.

PHOENIXVILLE, a borough in Chester Co., southeastern Pennsylvania, situated on the Schuylkill River at the mouth of French Creek, 28 mi. northwest of Philadelphia. It is served by the Pennsylvania and the Reading railroads. The local manufactures include structural steel and steel products, silk goods and paint. The value of the manufactured output, 1929, was \$15,517,905. The retail business in 1929 amounted to \$5,729,718. Phoenixville was settled in 1732 and became a borough in 1849. Pop. 1920, 10,484; 1930, 12,029.

PHONETIC LAW, a statement of regular correspondence, under like circumstances and conditions, between phonemes (sounds) in two or more languages or dialects, based on empirical observation and comparison, whether synchronically or diachronically (see **SYNCHRONIC GRAMMAR**; **DIACHRONIC GRAMMAR**), e.g., Gothic *ai* = Anglo-Saxon *d* = English *o* = Dutch *ee* = German *ei* (*stains*, *stán*, *stone*, *steen*, *stein*). There is no inherent necessity in the operation of such laws except in a very few cases, e.g., the combination of surd and sonant becomes sonant, *cat-s*, but *cad-s*, pronounced *cadz*). The explanation of such change must be sought mainly in physiological phonetics; the speakers of each successive generation seek to imitate exactly the pronunciation of their elders, but almost inevitably make slight phonetic changes, scarcely perceptible in themselves, but amounting to wide deviations in the course of time. Furthermore, a group of speakers entering a new language-area involuntarily adopts sounds of the speech of that region. In a broad sense, the maxim that "phonetic laws have no exceptions" seems true, the many apparent violations being due either to **ANALOGY**, to the fact that the terms showing these seeming divergencies are really **LOAN-WORDS**, to a misstatement of the law, or to the existence of another law hitherto unperceived. This maxim is, indeed, the basal principle of all **LINGUISTICS**.

L. H. G.

PHONOGRAPH, a device invented by THOMAS A. EDISON in 1877 for recording and reproducing sound. In its earlier forms, the essential features of the phonograph were: a rotating disc or cylinder of wax, or other soft material, on which a record of the sound is made in the form of a continuous wavy groove; a fine needle which, placed in the groove, follows its minute undulations as the disc or cylinder is revolved; a light, thin, diaphragm of mica, or similar material, clamped at the edges; a light lever, to one arm of which the needle is attached, the other arm being attached at the center of the diaphragm; a **HORN** to supply efficient acoustical coupling between

the diaphragm and the atmosphere. In operation, the undulations of the record impart a vibratory motion to the needle which in turn causes the diaphragm to vibrate and generate sound waves, reproducing the original sound from which the record was made.

In 1887, Emile Berliner patented the process of recording wherein the movement of the cutting stylus is to and fro over the surface of the wax cylinder, instead of in and out. Berliner also introduced the flat disc which has since supplemented the cylinder for phonographic reproduction.

Until 1925, records were made by the acoustical method. The cutting tool, of diamond or sapphire, was directly attached to the diaphragm placed at the vertex of a large horn, which was the only means of amplifying the original sound. Musicians or speakers were placed as nearly as possible to the mouth of the horn. The development of the vacuum tube amplifier (see **TUBES**, **ELECTRONIC**), and of a high-quality **MICROPHONE**, e.g., the condenser microphone, together with much fundamental research, have led to vast improvements in recording and reproducing. In electrical recording, the sound is picked up by the condenser microphone. The minute electrical currents, after amplification by distortionless vacuum tube amplifiers, operate the cutting tool. In the electrical phonograph, the needle is attached to the armature of what is essentially a **TELEPHONE** receiver, and its motion sets up minute electrical voltages in the field windings. After amplification, the current is supplied to a **LOUD SPEAKER**.

Many of the exact manufacturing processes used on phonograph records are trade secrets. In general, however, the original record is made in soft wax of stearin and paraffin. This is dusted with graphite to render it electrically conducting. Copper is electrically deposited on the wax which is then removed, giving a negative of the original in copper. From this copper negative, the original record is imprinted upon the permanent discs of harder wax. See **ELECTROLYSIS**.

P. E. S.

PHONOLITE, a dense, finely crystalline rock sometimes associated with gold veins. It is usually dull green or gray, but may be lighter in color. Identification of the component minerals is difficult without a microscope. They include orthoclase, nephelite, augite, and rarely hornblende. Phonolite is thus the fine-grained equivalent of the **SYENITES** containing **NEPHELITE**. The rock was formerly called clinkstone, because of its resonant sound when struck. Phonolite is from the Greek equivalent of that name.

Phonolites are found in the Black Hills, South Dakota, in Cripple Creek, Colorado, and in Germany. See also **PETROLOGY**; **LAVA**.

PHONOLOGY, scientific study of sounds (particularly of those produced by human beings), more accurately called phonetics; more specifically, the system of sounds in groups of languages, specific languages, etc. Although in any given language the number of sounds scarcely exceeds 60, the total number possible is very large. Since speech-apparatus does

not differ essentially anywhere in the world, any sound whatever may physically be produced by anyone who possesses normal vocal organs, supposed impossibility being due either to faulty audition or to ignorance of how exactly to adjust the vocal apparatus.

Knowledge of phonetics is highly essential for accurate recording and reproduction of sounds, notably in the telephone and radio. Here the human ear and even the most careful self-observation are apt to be lamentably faulty, more accurate results being obtained by observation through X-rays or by means of machines recording the vibrations of given sounds. From this point of view, the vowels are now fairly known; but obstacles in investigation of the consonants have not yet been overcome, the difficulty of the whole being increased by the fact that the same sound is not always produced in the same way, even by the same speaker.

Ordinary sounds (omitting such sporadic occurrences as the "clicks," or injected consonants, of HOTTENTOT, BUSHMAN and some BANTU languages) may be divided into vowels and consonants, the former produced essentially by vibration of the vocal chords with modification of the breath-stream in the buccal and nasal cavities, and the latter made by various restrictions of the breath-stream after passing those chords. Consonants, in their turn, are divided into occlusives (or stops, mutes), semi-occlusives or affricatives, spirants or fricatives, nasals and liquids, the first three subdivided into surds and sonants (or voiceless and voiced) the former characterized by complete closure of that part of the oral cavity concerned in their production ("implosion") followed by release of such closure ("explosion"), as *k*, *t*, *p*; and the latter marked by uninterrupted breath-stream after the part of the oral cavity concerned has been put in position, as *g*, *d*, *b*. A semi-occlusive consists of an occlusive plus a spirant, as *ts* (written *z*) in German *zehn*, or *dz* (also written *z*) in Greek *háxomai*. The spirant is produced by restricting the simple breath-stream, as *s*, *x*, *th* (*th-in*, *th-is*), *f*, *v*, *w*, *y*; the nasal by permitting part of the breath-stream to pass through the nasal cavity, as *n*, *m*; and the liquids are either lateral (*l*), formed by raising the tongue toward the palate while lowering its edges so as not to interrupt the breath-stream, or rolled (*r*), made by vibrating the tongue and the elastic parts of the oral cavity. Liquids, nasals and the spirants *y*, *w* may serve either as consonants or as vowels, e.g., *apple-tree*, *butter-milk*, *heaven-born*, *bosom-clasped*.

According to the position of their formation, sounds are classed as laryngeal (produced in the larynx), as *a*, *h*; velar (produced with the soft palate), as *q* in *quote*; palatal (with the hard palate), as *k*, *g*, *y*, *e*, *i*; cerebral or cacuminal (in the upper part of the oral cavity), as *sh* in *shin*, and *zs* (written *s*, as in *pleasure*); dental (with the teeth), as *t*, *d*, *s*, *z*, *n*; interdental (produced between the tongue and the teeth), as *th* in *th-in*, *th-is*; labiodental (between the lips and the teeth), as *f*, *v*; and labial (by the lips), as *p*, *b*, *w*, *m*, *o*, *u*.

In LINGUISTICS phonology forms the basis of all investigation (see LAW, PHONETIC). L H G.

BIBLIOGRAPHY.—P Rousselot, *Principes de phonétique expérimentale*, 1897-1909, H. Sweet, *Primer of Phonetics*, 2nd ed., 1902, E W Scripture, *Elements of Experimental Phonetics*, New York, 1902, O Jespersen, *Lehrbuch der Phonetik*, 2nd ed., 1911, H Panconcelli-Calzia, *Einführung in die angewandte Phonetik*, 1914, G O Russell, *The Vowel*, 1929.

PHORMIUM, a genus of plants of the lily family comprising two species found in New Zealand and Norfolk Island, one of which (*P. tenax*), widely cultivated for ornament, yields the valuable fiber known as NEW ZEALAND FLAX.

PHOSGENE, a suffocating gas, having the formula COCl_2 . It is manufactured by the union of carbon monoxide and chlorine at a temperature around 100°C . or less, with activated charcoal as the catalyst, although others are suitable. Phosgene is formed in a variety of chemical reactions chiefly that of the action of water on carbon tetrachloride, which takes place at almost any temperature.

Phosgene is a gas at ordinary temperature with melting point -75°C . and boiling point at 8.2°C . It possesses characteristic chlorine-like odor, is irritating and poisonous, and was used in warfare during the World War. It combines very readily in reactions involving the chlorine atom to form a large variety of products including some of commercial value in the pharmaceutical and dye field. E. C. BR.

PHOSPHATE ROCK, sedimentary rocks containing large amounts of calcium phosphate. These rocks may occur in beds with limestone, marl, shale, or sandstone, or as pebbles and boulders washed out of phosphatic strata by surface streams, or as residual, weathered-out material.

The phosphate in these is derived mainly from such remains as shells, bones, or excrement, especially of marine animals. The beds are largely calcium carbonate and calcium phosphate. Some phosphatic strata in western United States are ascribed to direct chemical precipitation of calcium phosphate from sea water.

Where weathered, the phosphate rocks are softer and richer than elsewhere, as in the Tennessee rocks, for example, where much calcium carbonate has been leached out, leaving a richer, easily mined phosphate rock near the surface. In Florida the production is from pebbles and boulders which have been water transported.

Phosphate rocks are the source of most of the world's supply of phosphate fertilizer. In order to make the phosphate soluble, the rock is treated with sulphuric acid. Natural phosphates are also used to manufacture H_3PO_4 , phosphoric acid, and phosphorous compounds for matches, poison gases, refractory bricks.

The United States is the largest phosphate rock producer. Other sources are in Tunis, Algeria, and Egypt. See also APATITE; GUANO; PETROLOGY; WEATHERING.

PHOSPHATES. Aside from the "acid phosphates" and "superphosphates" of the fertilizer trade, the principal salts of phosphoric acid used commer-

cially are the phosphates of sodium, calcium and ammonia. The glycerophosphates (salts of glycerophosphoric acid, which is made by combining glycerine with phosphoric acid) are important in medicine, but do not represent any great tonnage.

Three sodium phosphates are made: mono-, di-, and tri-sodium phosphates. Di-sodium phosphate is obtained by mixing phosphoric acid and soda ash solution in the proper proportions. Tri-sodium phosphate is made from di-sodium phosphate solution by the addition of caustic soda; mono-sodium phosphate from di-sodium phosphate solution by the addition of phosphoric acid. Mono-sodium phosphate, the least important commercially, is used to some extent in medicine and in certain baking powders; di-sodium phosphate is used in large quantities for weighting silk.

Tri-sodium phosphate, a strong alkali, finds its chief use as a household water-softener and cleanser. Mixtures with modified soda, soda ash, soap, etc., are sold as cleaning mixtures for laundry work, bottle washing and metal cleaning. Tri-sodium phosphate softens water by precipitating lime and magnesia, the two principal causes of hardness, as phosphates. It has found some application in the softening of boiler feed water. Because of its emulsifying power the use of tri-sodium phosphate with soap reduces the amount of soap required. Certain other phosphates of sodium have minor applications.

Of the ammonium salts of phosphoric acid only the mono- and di-ammonium phosphates are important commercially. These are white crystalline materials made by the action of ammonia on phosphoric acid. The mono-ammonium salt is used in yeast culture and fermentation and both the mono- and the di- salts are used in fireproofing, especially for the treatment of wood splints for matches to prevent afterglow. Some di-ammonium phosphate is used in sugar refining, and the crude grades of both salts are finding increasing use in concentrated fertilizers to which they supply nitrogen and phosphorus. (*See also FERTILIZERS.*)

The three calcium phosphates, all being relatively insoluble, are formed either by treating milk of lime with the requisite quantity of phosphoric acid or by the interaction of the corresponding sodium phosphate and a soluble salt of calcium. Tri-calcium phosphate, $\text{Ca}_3(\text{PO}_4)_2$, occurs naturally as phosphate rock and is also the chief inorganic constituent of bones. The principal uses of the manufactured calcium salts are in baking powders and tooth powders and pastes.

C. H. P.

PHOSPHORESCENCE. *See* FLUORESCENCE.

PHOSPHORIC ACID, a water-white, odorless liquid, formula H_3PO_4 , which has a syrupy constituency in high concentrations. It is manufactured commercially by three different methods: (1) by treating ground phosphate rock with sulphuric acid and filtering off the calcium sulphate which is formed; (2) by heating phosphate rock, coke, silica and iron in a closed electric furnace—the coke reduces the

phosphate in the rock to phosphorus, which is volatilized, oxidized in the vapor state with air and condensed with moisture or electrically precipitated to form a crude acid of 85 to 95 per cent H_3PO_4 content; and (3) by using the same raw materials, the operation being conducted in a blast furnace instead of an electric furnace, using an excess of coke as fuel and a blast of air to drive out the liberated phosphorus. The crude acid is then further treated to remove lime, lead, arsenic and fluorine which are present as impurities, and is adjusted to the desired strength.

Phosphoric acid is marketed usually in 50% or 75% strength (H_3PO_4 content). While it is generally considered to be very corrosive, its acid value is considerably below that of hydrochloric, nitric and sulphuric acids.

Phosphoric acid is used to the greatest extent in the preparation of various phosphate salts (*see* PHOSPHATES). The crude grade obtained by the treatment of phosphate rock with sulphuric acid is used after concentration for further treatment of more rock to produce "superphosphates" for fertilizer use (*see* FERTILIZERS). Pure phosphoric acid, as such, is used to impart the desired sourness or sharp taste to soft drinks and to some jams and jellies. It is the only inorganic acid which has generally been accepted as a wholesome ingredient, it being claimed that it has a certain medicinal value.

An important application of phosphoric acid is in the rust-proofing of iron and steel, especially automobile bodies and smaller machined parts and tools. A very adherent coating of iron phosphate is deposited on the surface of the treated article, the dimensions and sharpness of finely machined edges and surfaces not being appreciably altered by the treatment.

Mixtures of phosphoric acid and alcohol are used for removing rust from iron and steel surfaces before painting. The acid alone has been used to some extent in conditioning boiler feed water, though the phosphates are usually preferred. A very pure grade of acid is used in mixing dental cements.

Phosphoric acid paste, a mixture of lime and pure phosphoric acid, is used in sugar refining for the defecation of raw sugar solutions. It is made in both dry and wet grades, each containing the equivalent of 50 to 53 per cent P_2O_5 .

C. H. P.

BIBLIOGRAPHY.—W. H. Waggaman and H. W. Easterwood, *Phosphoric Acid, Phosphates and Phosphatic Fertilizers*, 1927.

PHOSPHORUS, a non-metallic element (symbol P, atomic weight 31.02), occurring in various modifications, differing markedly in appearance and physical properties. When phosphorus vapor is suddenly cooled, it solidifies to a white mass consisting of soft wax-like crystals known as white phosphorus or allotropic phosphorus, melting at 44°C ., and with a boiling point at approximately 290°C . Phosphorus also occurs as a crystalline product having a specific gravity of 2.19. The violet phosphorus is another crystalline modification, melting at 600°C ., which is

much less volatile and active than the yellow phosphorus. The yellow allotropic form is official in the U.S. Pharmacopoeia.

Phosphorus in form of compounds is a constituent of all living organisms, and as phosphates is used widely in both medicine and in commercial applications, such as for fertilization of the soil. Medicinally, small doses of phosphorus are used to stimulate the formation of bones in cases of poorly uniting fractures; its use as a nerve food and stimulant has been based on false premises. Toxic doses of phosphorus produce nausea, vomiting, and diarrhea, while those working with phosphorus may be subjected to chronic poisoning, shown by necrosis of the lower jaw.

When administered in the form of phosphates, such as sodium phosphate, or in phosphorus-containing foods, such as lecithins, it finds wide application. Phosphorus compounds occur in the bones as insoluble calcium and magnesium phosphate, as soluble phosphate ions in blood plasma and other body fluids, as organic compounds (nucleins, lecithins, and phosphatides) in tissues and plasma. In order to maintain the phosphorus balance in the body, phosphates are given, particularly in rickets (along with calcium compounds and Vitamin D effect-producing agents, such as cod liver oil, viosterol, ultra-violet light, and sunshine).

The chief acid of phosphorus is *phosphoric acid*. Its medicinal actions are similar to those of hydrochloric acid. It possesses none of the therapeutic properties of elemental phosphorus. (See also PHOSPHORIC ACID.)

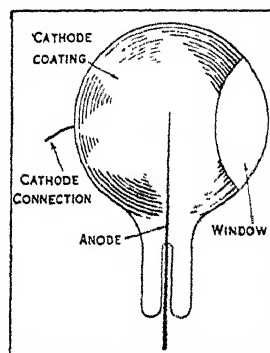
The bibasic sodium salt of phosphoric acid, *sodium phosphate* ($\text{Na}_2\text{HPO}_4 \cdot 12\text{H}_2\text{O}$) occurs as large, colorless, odorless, efflorescent crystals or powder having a saline taste; freely soluble in water but only slightly soluble in alcohol. It is used as a saline cathartic. (See also PHOSPHATES.) P. N. L.

PHOTOCHEMISTRY, a branch of chemistry in which is studied the influence exerted by light upon various reactions, which influence may manifest itself in a variety of ways. In the basic processes of photography, the action of light is to decompose silver bromide with liberation of bromine; upon a mixture of hydrogen and chlorine gas, the effect of light is a colossal acceleration in the speed of reaction which, normally slow, now becomes explosive. The decomposition of such organic substances as orange juice and milk under the influence of light is well known, while, furthermore, it seems to accelerate polymerization and the tautomeric interchange of atomic groups within molecules, changing formaldehyde into its polymerides. Of the greatest importance, however, is the action of light in the process known as photosynthesis, as yet but imperfectly understood, in which carbon dioxide and water-vapor with the aid of light, and in the presence of chlorophyll, the green coloring matter of plants, are synthesized into starch. The process taking place in the retina of the human eye, where the "visual purple" is bleached by the action of light, but regenerated again in darkness is another

photochemical process of paramount interest. In general, though not invariably, blue and ultra-violet rays have a stronger influence than red and yellow rays, for which reason the former are often called the actinic rays. W. J. L.

PHOTO-ELECTRIC CELL, a device in which an electric current is regulated by means of light (see ELECTRONICS). It is used in talking MOTION-PICTURES, in TELEVISION, for measuring intensities of illumination and for many other purposes. Its action depends on the ejection of ELECTRONS from some metal, usually POTASSIUM, by the action of incident light. This photo-electric effect is a common property of matter, but most substances are sensitive only to radiation outside the visible SPECTRUM, in the ultra-violet (see ULTRA-VIOLET RADIATION) and beyond.

The potassium, or other sensitive metal, is deposited in a layer on the inside surface of a glass bulb filled with an inert gas at reduced pressure, and a wire passing through the wall of the bulb makes electrical connection with this metal.



COURTESY, ELECTRONICS

PHOTO-ELECTRIC CELL

Another wire entering the bulb is insulated from the layer. Between these two electric terminals of the cell a moderate voltage is applied. When electrons are ejected by light from the metal deposit, a small current passes through the cell. This current may be amplified and made to operate some device, as a LOUD SPEAKER in talking moving-pictures. Or it may be amplified and measured to determine the intensity of the illumination. The cell responds unequally to light of different colors, and its selectivity is quite different from that of the eye. But, by the use of a suitable light filter (see FILTERS, LIGHT), it may be made to indicate quite closely intensities of illumination as the eye sees them. See also QUANTUM THEORY; PHOTO-ELECTRICITY. R. T. C.

PHOTO-ELECTRICITY, electricity produced by the ejection of ELECTRONS from materials under the action of LIGHT, X-RAYS or GAMMA RAYS. A flow of photo-electric current results when the electrons emitted by a freshly polished zinc plate irradiated with ultra-violet light are drawn over to a positively charged metal plate in the neighborhood. Photo-electric cells are made by depositing such chemicals as sodium or potassium hydroxide or caesium oxide on the inner walls of evacuated glass bulbs. The light enters through a window, and the electrons emitted by the metals are drawn over to a positively charged metal electrode sealed in the center of the bulb.

There are four photo-electric laws of major importance. First, for a given COLOR or WAVE-LENGTH of the incident light, the strength of the photo-electric

current varies directly with the intensity of the light. If the amount of light is doubled, the current becomes exactly twice as great; if trebled, the current will be three times as large. Second, the response to changes in the intensity of the light is practically instantaneous, taking place in one-hundred-millionth of a second. The third law states that, for equal intensities of the incident light, different colors or wave-lengths cause photo-electric currents of different strengths. In all cases, the currents are greater for the shorter waves, such as the ultra-violet. If long waves are used, there will be no photo-electric current. The cut-off point, known as the photo-electric, long-wave-length limit, is different for different emitting surfaces. It lies in the long wave, or red, end of the spectrum for caesium, potassium and sodium. The fourth law, first enunciated by EINSTEIN, assumes that the incident rays are made up of bundles of energy, quanta, whose size depends directly on their frequency or inversely on their wave-length, and that each quantum completely transfers its energy to one ELECTRON (see QUANTUM THEORY). At the long-wave-length limit, one quantum is just sufficient to remove one electron from its ATOM and get it through the surface of the metal. For all shorter rays there is a surplus of energy in each quantum which gives the ejected electron an initial velocity.

By introducing a small trace of inert gas, such as neon or argon, into the evacuated PHOTO-ELECTRIC CELL, much larger currents will be produced because new ions are formed when the ejected photo-electrons collide with the neutral gas ions (see IONIZATION).

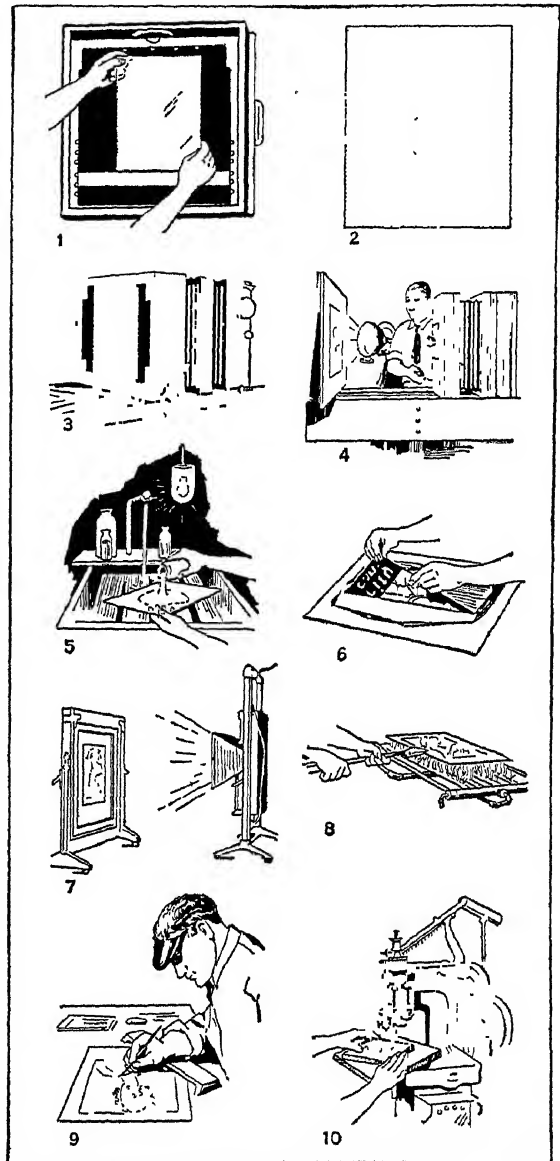
J. B. H.

PHOTO-ENGRAVING, a printing plate-making method by which photographic reproductions of drawings, pictures and other flat representations are produced on metal plates. The photographic image on the metal plate is etched in relief with acids, after which such plates can be printed from on a typographic press. Impressions from these plates produce the illustrations that accompany the type matter in books, newspapers, advertising matter, etc., and they are actual photographic copies in printing ink of the original pictures of drawings. There are two kinds of photo-engravings: halftones and line plates. These are subject to innumerable variations and combinations, from those to be printed in black ink only, to reproductions of paintings and objects in full color.

Halftone Plates. These are so called because the continuous tone gradations of light and shade, or "halftones," that exist in photographs and paintings are reproduced. This is accomplished by the use of a "halftone screen," consisting of two glass plates, each ruled with single black lines; these plates are cemented together with the lines crossing at right angles, this forming a screen of equally spaced openings or windows through which the light reflected from the original photograph or painting passes inside the camera when making the photographic halftone negative. The screen breaks up the picture image into dots of varying sizes, being very small in

the highlights and gradually becoming larger as the tones become darker. The examination with a magnifying glass of an impression from a halftone plate in a magazine or newspaper will clearly show this dot formation.

Halftone screens vary in ruling from 50 to 200



COURTESY BALTIMORE MARYLAND ENGRAVING CO

PROCESSES IN MAKING A HALF-TONE ENGRAVING

1, Placing the wet plate in the plate holder, 2, a halftone screen; 3, halftone screen placed in camera, 4, photographing the copy; 5, developing the plate, 6, printing the negative, 7, printing through the negative, 8, burning in the copper plate, 9, blocking the plate, 10, blocking the plate

lines per inch. The paper on which the halftones are to be printed governs the screen ruling. Newspapers require a coarse screen; as the paper quality improves finer screens are used. The finer the screen the more detail is retained in the plate. Fine screen halftones are etched on copper, and the etching done with a solution of iron chloride. Coarse screen halftones are

generally etched on zinc. A high degree of artistic skill and experience is involved in the production of halftone plates.

Highlight Halftones. These are halftone plates in which the dots that are usually present in the highlight have been completely etched away, as in reproductions from pencil and crayon drawings. A "shop" term for such plates is "drop out" halftone, meaning that the highlight dots have been dropped out in the negative or in etching.

Color Process Plates. These are also halftone plates, and their production is based on the principle that all natural colors can be reproduced by the three primary colors mixed in the right proportion. Practical application has not reached the perfection of the theoretical principle and while good work is done in three colors only, the addition of a fourth plate, usually printed in black ink, materially improves the color reproduction. Oil paintings, water-colors and pastels form the usual original subjects from which color process plates are made, but these can also be made directly from colored objects. To explain the process as briefly as possible, only the three color process will be mentioned, as this is the basic foundation. A yellow, red and blue halftone printing plate is required. The first step consists in making a "color-separation" halftone negative for each of these color plates; these are made on special color-sensitive photographic plates and are exposed one at a time, in the camera through a blue, green and red color filter. The function of the filter is to trap or absorb the light that should not act on the photographic plate and allow only that light to pass that should form the photographic image. The blue color-filter is used for producing the color-separation negative for the yellow printing plate, the green filter for the red printing plate and the red filter for the blue printing plate. These filters are practically complementary in color to the color of the printing inks. From each of these color-separation halftone negatives, an acid resisting photographic print is made on a sheet of copper and these are etched in relief. Up to this stage no colors are visible; the color photographer and etcher must "see" color in terms of gray or black and white on the negatives and during etching, and the actual colors only appear when the etched plates are printed with the yellow, red and blue inks superimposed one over another on the printing press. Exceptional painstaking care and skill is required from beginning to end in making color-process reproduction plates.

Line Etchings. These are reproductions from originals that are pure black and white, containing no intermediate tones; such as pen and ink drawings in line or black crayon drawings in grain or stipple, on white paper. The drawings can also be in white on black paper. No halftone screen is used on these plates. The original subject is copied in the camera on a photographic plate that is capable of producing a negative of extreme contrast; from this an acid-resisting photographic print is made on sheet zinc

which is then etched into relief in a bath of dilute nitric acid. Such plates are commonly known as zinc or line etchings.

Line work can also be etched on copper, this being frequently done when the subject contains a great deal of fine detail, such as a wood or steel engraving. Pencil or delicately shaded crayon drawings will not produce satisfactory line plates; these should be reproduced by the halftone process.

Benday Process. A method invented by Benjamin Day (1810-89) for hand-transferring shading effects or intermediate tones, in the form of dots, lines, stipple, and other texture patterns into line reproductions. These shading tints can be applied to the original drawing, but it is more practical to leave the drawing in outline and apply the shading tints on the metal before etching. Excellent effects are produced by this method in making color printing plates and the most common examples of this are the feature and comic sections of Sunday newspapers. L. F.

BIBLIOGRAPHY—S. H. Horgan, *Photo-Engraving Primer*, 1920; H. A. Groesbeck, Jr., *The Process and Practice of Photo-Engraving*, 1924; L. Flader, *Art of Photo-Engraving*, 1929.

PHOTOGRAPHIC OBJECTIVE, a LENS used for making a photographic exposure. The "speed" of an objective may be designated by the "F system" or "uniform system" U.S., of numbering. In the F system, the expression, $F/4$, often written $F:4$, indicates that the maximum value of the relative aperture is $\frac{1}{4}$ or, in other words, that the maximum aperture has a diameter equal to one-fourth of the focal length. The speed of a lens is directly proportional to the square of the relative aperture, an $F/2$ lens, therefore, being four times as fast as an $F/4$. The U.S. number is inversely proportional to the speed and directly proportional to the required exposure. In the table below, equivalent F and U.S. values are given in vertical columns and the speed represented by any column is twice that of the next column to the left.

F	64	45.2	32	22.6	16	11.3	8	5.6	4
U.S.		256	128	64	32	16	8	4	2	1

The simplest photographic objective is the achromatic meniscus composed of two components cemented together. The maximum speed for a lens of this character is of the order of $F/16$. The rapid rectilinear lens, so called because of its freedom from distortion, consists of two symmetrically placed doublets and has a speed as great as $F/11$. Lenses which are particularly well corrected for astigmatism and curvature of field are termed *anastigmats*. Their speed is usually $F/6.3$ or greater. Within the last few years, lenses of very large relative aperture have been made available. Apertures of $F/3.5$, $F/1.9$ and even $F/0.95$ are used. The requirements of the motion-picture camera (see MOTION-PICTURE) have had an important influence in the development of high-speed lenses. For motion-picture work, lenses of comparatively short focal length are employed, and, with the shorter focal lengths, it is less difficult to

design a lens of large relative aperture. Furthermore, motion-picture photography, particularly colored motion-picture photography (*see* COLOR PHOTOGRAPHY), demands high speed if satisfactory results are to be obtained with average illumination.

Photographic objectives are classified, not only on the basis of speed, but also in accordance with their purpose. A *portrait lens* is a "fast" lens, adapted for portraiture, which gives good definition at the center of the field but which may not be so well corrected at the edge of the field as an anastigmat. A *process lens* is designed for the use of the photo-engraver. It is characterized by freedom from distortion and correction for chromatic difference in size of image. *See also* PHOTOGRAPHY. I. C. G.

PHOTOGRAPHIC SURVEYING, the production of maps from photographs; it is the most satisfactory for mountainous or extremely rugged regions. Two photographs of the same area are taken from the ends of a base line and at a known angle to each other. To make a topographic map (*see* TOPOGRAPHY), a certain amount of triangulation (*see* SURVEYING) is necessary in order that the true distances between landmarks in the photograph may be known. With this data it is possible to copy the photographs by a photographic process or to view them in special apparatus in such a manner that the effect of camera tilt and variation of height are compensated for. The photographs are viewed stereoscopically and a semi-automatic method is provided by which the map is plotted to an enlarged scale with contour lines.

For the construction of maps from airplane photographs, the more important phase of photographic map making, *see* AERIAL SURVEYING. I. C. G.

PHOTOGRAPHY, the production of a photograph depends upon the sensitivity of certain silver salts to LIGHT. A photographic plate, or film, has a base of glass or celluloid, respectively, which carries a layer of light-sensitive emulsion. This emulsion primarily consists of grains of silver bromide in a layer of GELATINE. By means of a PHOTOGRAPHIC OBJECTIVE, an image of the object to be photographed is formed upon the photographic emulsion. The image effects a change in the silver salt in the emulsion, the amount of the change varying in accordance with the brightness of the image. As a result of this change, the silver bromide which has been affected by the light is reduced, upon development, to metallic silver. The silver bromide unaffected by the light remains unreduced and is subsequently dissolved out by a solution called the *fixing bath*, after which the plate is washed and dried. The result is a reproduction of the image, opaque, by reason of the finely divided metallic silver, where the image was bright, and transparent, because of the removal of the silver bromide, where the image was dark. As a consequence of this interchange of light and dark, the reproduction, at this stage, is termed a *negative*.

Paper, coated with a layer of light-sensitive emulsion, is termed *printing paper*. A sheet of printing

paper is placed in contact with the negative and the emulsion exposed to light through the negative. Upon development and fixing, an image results upon the paper, and this image, being the reverse of that on the negative, is a *positive*, i.e., its light and shade are the same as in the original object. This positive constitutes the finished photograph. The process of exposing the paper, in the manner outlined, is termed *contact printing*.

Instead of printing by contact, a real image of the negative may be formed on the paper by means of a LENS. By suitable placing of negative, lens and paper the image may be made either smaller or larger than the negative. This is the method by which enlargements or reductions are made. A photograph may be made of another photograph, in which case the process is termed *copying*. A special camera with a long bellows extension and a special support to carry the picture to be copied is termed a *copying camera*. *See also* COLOR PHOTOGRAPHY; PHOTOGRAPHY, AERIAL. I. C. G.

PHOTOGRAPHY, AERIAL. Cameras for taking pictures from airplanes have the focus fixed for infinity and commonly employ films (*see* PHOTOGRAPHY). Panchromatic emulsions with filters (*see* FILTERS, LIGHT) which absorb the blue light are necessary in order to lessen the effect of atmospheric haze. If the photographs are to be used for the construction of mosaics or maps, the camera is permanently mounted in the plane so that it points downward through the fuselage, and an automatic shutter is provided by which the exposures are made and the film advanced at regular intervals. A multiple-LENS camera consists of two or more cameras mounted together at fixed angles with each other. Photographs with all the cameras are taken simultaneously, and, in this way, a large area may be photographed at the same time. The photographs taken with the cameras which are not vertical will be distorted, and the distortion is removed by a special copying camera, called a *transformer*. *Oblique pictures* are photographs taken from an airplane with a camera which deviates markedly from the vertical. *See also* AERIAL SURVEYING. I. C. G.

PHOTOGRAPHY, ASTRONOMICAL. Photographic methods have completely or partially superseded the visual ones in nearly all branches of astronomical observation, with the notable exception of direct observation of the precise absolute positions of the sun, planets and brighter stars by means of the meridian circle, and the observations of planetary surfaces and of double stars.

The advantages of photography are obvious. The element of human fallibility is eliminated to a very large extent, as the photographic plate does not make a mistake in writing down the wrong number or the wrong time, as an observer may do. It constitutes a record of comparative permanence, which may be consulted over and over again, and represents an enormous gain in efficiency in that it permits the observation of a large number of stars at once, instead

of only one at a time as in the visual method. Finally it allows of a division of labor since the actual photographs are taken at night, often by a comparatively unskilled person, while their examination and measurement can be carried out in the day time, under office conditions, and by a person who is not handicapped by sitting in a cramped position under a telescope.

During the time that photography has been employed in astronomy a number of observatories have gradually built up large collections of plates, which are invaluable in that they constitute a reference library and a history of the sky for the past forty years in which all celestial happenings in that interval of time may be investigated. For most types of observation, especially those concerned with very faint stars, the fastest plates available are used, but for work where the greatest precision in the position of the stars is required, slower plates, with finer grain, are utilized. Exposure times may range anywhere from a second to 100 hours, depending entirely upon the problem investigated. Generally only the usual blue-sensitive plates are used in astronomical photography. Occasionally, however, especially in researches concerning the brightness of the stars, isochromatic plates are employed in connection with yellow filters. The accurate determination of stellar brightness by measuring the photographic images of the stars is subject to great difficulties owing to the circumstance that the amount of blackness collected in the photographic image is not proportional either to the amount of light that falls on the plate or to the length of exposure, but depends on both in a much more complicated manner. The dependence has to be investigated for each plate separately. W. J. L.

PHOTOGRAPHY, SPARK. See SPARK PHOTOGRAPHY.

PHOTOGRAVURE AND ROTOGRAVURE, two processes of photo-mechanical intaglio printing. Photogravure, of which rotogravure is a variation, was invented in 1895 by Karl Klietsch, a German. As improved by Klietsch and Samuel Fawcett, an Englishman, it was called the Rembrandt Process. Now many magazines and books are illustrated by means of photogravure, and nearly all Sunday newspapers include a Rotogravure Section.

Photogravure printing is done from a copperplate upon which a photograph has been etched in reverse. The principal materials required, besides the press, are a copperplate, a mordant to bite the plate, and a resist to protect those portions of the plate not intended to print. (See also ETCHING.)

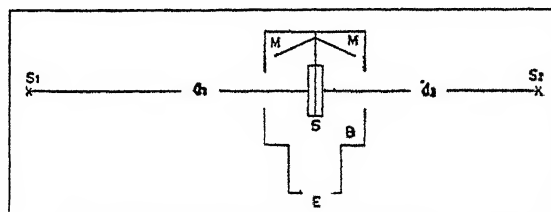
Most important in photogravure is the making of the resist. The resist is originally a carbon tissue. This is a thin sheet of paper coated with a gelatin solution, containing some red pigment and bichromated to make it sensitive to light. Over the carbon tissue is placed a reversed positive, called a transparency, of a negative of the selected photograph. Light is passed through the reversed positive and strikes the carbon tissue, the gelatin of which becomes in-

soluble wherever touched by light. The tissue is again subjected to light through a ruled screen, having 150-175 lines per sq. in. (See PHOTO-ENGRAVING) Hot water washes away all but the insoluble gelatin. The copperplate, covered by the completed resist, is finally treated to a bath of ferric chloride, which bites the copper through the tiny lines and areas of the resist. After sufficient etching the plate is ready for the press.

Rotogravure. This is photogravure-printing done on a rotary press. The etching is made on a copper-surfaced cylinder or a thin copperplate which can be rounded out to fit a cylinder. As the etched cylinder revolves in the rotary press it is inked, being cleaned of all superfluous ink by a thin strip of steel, called a "doctor." Paper is fed to the press by hand or from a reel. By using several etched plates or cylinders photogravure or rotogravure may be done in colors.

PHOTOLITHOGRAPHY. See LITHOGRAPHY
PHOTOMETER, an instrument used to measure the luminous intensity, or CANDLE-POWER, of a source of light or the illumination at a given surface by comparison with some standard source of illumination.

The Bunsen, or grease-spot, photometer consists of a box, *B* (see figure), called the "head" of the



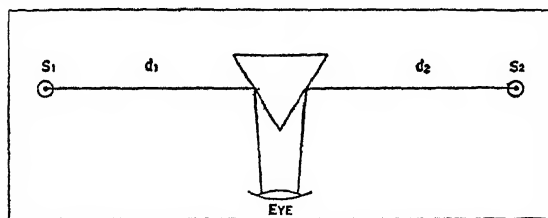
BUNSEN PHOTOMETER SET-UP

photometer, blackened on the inside and containing a sheet of opaque white paper, *S*, a small circular section of which has been made translucent by application of paraffin wax. The box, *B*, is placed on a carriage which may be rolled along two rigid rods, called the photometer "bench." The unknown source, *S*₁, and the standard, *S*₂, are placed at opposite ends of the bench, and the box, *B*, is rolled along until the two sides of the paper appear identical. The eye is placed at *E*, and the mirrors, *MM*, serve to make both sides of *S* visible simultaneously. Since, for relatively large distances and small sources, the intensity of the illumination upon a given surface varies inversely as the square of the distance from the source of light and directly as the candlepower of the light, when *S* appears equally bright on both sides,

$$\frac{I_1}{d_1^2} = \frac{I_2}{d_2^2}$$

Here, *I*₁ and *I*₂ are the candle-powers of the unknown and of the standard, respectively; *d*₁ is the distance between the unknown source, *S*₁, and the screen, *S*; *d*₂, the distance between the known source, *S*₂, and the screen, *S*.

As the Bunsen type of photometer head is not sufficiently sensitive for accurate work, a photometer head developed by Lummer and Brodhun in 1889 is used. This is moved back and forth until equality of contrast between two patterns is obtained, rather than



PHOTOMETER SET-UP

The box is moved until light from S_1 reaches the eye with the same intensity as that from S_2

equal brightness of two fields. The eye is much more sensitive to this effect.

Illumination photometers are used to determine the illumination at some given position. A dull white surface is placed in that position and its brightness is compared with that of another surface within the instrument. The illumination of the latter can be varied until a photometric match has been obtained. A previously calibrated scale on the instrument gives directly the illumination at the desired spot. There are many different variations of this form of photometer.

When lights of the same, or of nearly the same, color are to be compared, the above methods are satisfactory, but, when the colors differ appreciably, other methods must be used.

The cascade method of comparing the intensities of two lamps of different color uses a series of sub-standard lamps which have approximately equal color-differences. The unknown is first compared with the sub-standard nearest it in color, and that in turn with the next sub-standard, and so on until the lamp having the desired color is reached.

The flicker method is also widely used. The two surfaces, illuminated by the two lights to be compared, are presented alternately to the eye at a certain frequency and the brightness of one or the other is varied until the "flicker" disappears.

The difference in color between two sources to be compared may also be removed by placing between the photometer and one of the sources a light filter (see FILTERS, LIGHT) of such a tint as to make the two appear to have the same color. Perhaps the most accurate way of comparing two sources of different color is to separate each source into its component wave-lengths and compare the intensities of the two at as many points in the spectrum as desired. This is done by means of a *spectrophotometer*.

Instead of varying the intensity of the standard by changing its distance from the photometer head, a rotating sector disc which cuts off a known fraction of the light from the standard, may be used, or the light from the standard may be made to pass through two Nicol prisms (see POLARIZATION OF LIGHT) whose

percentage of transmission may be made to vary according to a simple law.

T. S.

PHOTOMETRY, the measurement of the intensity of light sources or intensity of illumination by comparison with certain arbitrary standards. To measure intensity of source the usual standard is the **CANDLE-POWER**. The amount of light or luminous flux passing through a solid angle of one radian from a one candle-power source is defined as the *lumen*. Such a source, therefore, emits in all directions a total of 4π lumens. To measure illumination, the usual standard is the foot-candle, this being the intensity of illumination at a distance of one foot from a standard candle. The most useful law in this field is the inverse square law, which states that the intensity of the illumination on a surface varies inversely as the square of the distance from the source. This is strictly true if the source is a point, and substantially so if the distance to the source is large compared to the dimensions of the source; otherwise, an integration over the surface of the source, treating each point separately, is necessary.

The intensity of illumination in ordinary daylight is about 10,000 foot-candles, and in full moonlight, about 0.03 foot-candles. For ordinary reading, an intensity of two to four foot-candles is sufficient.

Spectrophotometry is a development of photometric measurements by which the light is spread out in a **SPECTRUM** and the energy in each portion of the spectrum measured by comparison with the spectrum of a standard source.

P. I. W.

BIBLIOGRAPHY—R. A. Houstoun: *Treatise on Light*, 1927

PHOTOMETRY, CELESTIAL, that branch of astronomy concerned with determining the exact brightness of objects in the sky. In the visual method the brightness of a star is directly compared with some standard source of light by means of a specially designed instrument, the photometer. In the photographic method exposures of equal length are made on the field of stars for which the brightness is to be determined and on a field of stars where the brightnesses are known. To serve as standards in both types of observation a number of sequence of stars of graduated brightness in various parts of the sky have been selected and measured with great care. The brightness of a star is always expressed in magnitudes. Larger numbers indicate smaller brightness.

PHOTON, a unit particle of radiant energy such as **HEAT**, **LIGHT** or **X-RAYS**. The photon is analogous to the **ELECTRON** as the unit particle of electricity, or the **PROTON** as the unit particle of mass. However, photons of heat contain little energy, while light, ultra-violet light and X-rays possess increasing amounts of energy.

The idea of a photon had its origin in the **QUANTUM THEORY** devised by **PLANCK** in 1900 to account for **BLACK-BODY RADIATION**, and has been subsequently verified by the photo-electric equation of **EINSTEIN** and by the Compton effect and the Raman effect. In this work, it has been shown that the energy in ergs contained in each photon is given by the product

of Planck's constant, $h = 6.55 \times 10^{-27}$ erg-sec., and the FREQUENCY of the radiation. Thus, the rays of higher frequency, or shorter wave-length, are made up of photons, or quanta, of greater energy content.

J. B. H.

PHOTOSPHERE, the luminous surface of the SUN.

PHOTOSYNTHESIS, the manufacture of carbohydrates from carbon dioxide and water by means of energy the green tissue of plants derives from light. The carbon dioxide used comes from the air where there is a nearly constant supply of three parts per ten thousand. The water used by most green plants is absorbed from the soil and carried up the stem to the green leaves. The important part is the uniting of the elements of these two inorganic compounds to form sugar. This can be done only in living protoplasm in the presence of chlorophyll and in light. The chlorophyll is confined in small green bodies known as chloroplasts. Here the kinetic energy of light is stored up in sugar to form potential energy. This is a function of green plants alone and is the most important chemical process in the world because all living things are dependent upon it—it constitutes the sole source of organic food. Sugar constitutes the basis for the formation of the more complex compounds (starches, cellulose, gums, oils, amino acids, proteins and the like), which are also made only in living protoplasm. Animals can not manufacture their own food. They can only transform organic food into new forms and are, therefore, directly or indirectly dependent upon plants.

In addition to the food supply man is dependent upon the process of photosynthesis for clothing, shelter and fuels such as wood, coal, oil or gas. When organic materials are oxidized to carbon dioxide and water as in respiration or burning, the potential energy is changed back to kinetic. Fortunately the sun seems to have an unlimited supply of energy and as long as temperature and other conditions are favorable the green plants will continue to work for man.

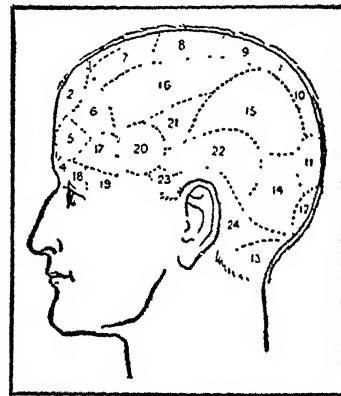
P. W. Z.

PHRATRY, the name given to a group within a primitive tribe, usually composed of several clans, within which marriage is forbidden. The Kariera of Australia divide the tribe into halves and each half into two phratries. A man is forbidden to marry, not only within his own phratry, but within his own half of the tribe. His children belong to his half of the tribe but to the other phratry within it. Other Australian tribes have, not four phratries, but eight with corresponding complications. Phratry systems were also found among the Iroquois of North America.

PHRENOLOGY, a system of reading character traits from the marked development of parts of the skull. The theory was advanced by Gall, a distinguished anatomist (1757-1828). It was developed by his associate Spurzheim (1776-1832), who brought it to America where it gained great vogue in the early 19th century.

The system rests upon three false assumptions: 1 that the contours of the skull conform minutely to the relative development of the underlying portions of the brain; 2 that the brain is divided into highly specialized functions; 3, that these are as described by Gall and Spurzheim. The last is the most remote supposition since the so-called organs or faculties are arbitrarily selected, overlap, and have no relation to cerebral, or brain, localization.

Gall's confidence in the truth of his localizations led him to explain that animals that do not sing lack the part of the brain in which resides the organ of tune, and that the mental characteristics of races could also be correlated with cranial development. Gall and Spurzheim "phrenologized" the prisoners and the insane and from their head-forms deduced the specific character of their crimes or delusions. The practice of phrenology rapidly degenerated to that of a fortune-telling art, having no scientific support.



LOCATION OF THE PHRENOLOGICAL FACULTIES, AS DESCRIBED

BY F. J. GALL

1, Sense of size; 2, sense of causality; 3, disposition to imitate; 4, sense of color; 5, sense of time; 6, wit; 7, sense of wonder; 8, optimism; 9, firmness of character; 10, vanity; 11, constancy in friendship; 12, philoprogenitiveness; 13, amateiveness; 14, acquisitiveness; 15, cc; 16, sense of melody; 17, sense of order; 18, sense of order; 19, acquisitiveness; 20, mechanical sense; 21, acquisitiveness; 22, cunning; 23, love of food; 24, cruelty

The accompanying chart and list of "organs" indicates the arbitrariness of the locations as well as of the divisions of human traits. How completely prejudiced observation may influence an able mind is shown in the acceptance by James Braid, the first scientific student of hypnotism, of the phrenological view. By binding a cork tightly over the organ of veneration in a hypnotized subject, actions appropriate to that faculty were induced. This "phreno-hypnotism," evidently the result of suggestion, Braid afterwards abandoned. Here and there a man of science has attempted to reinstate phrenology more in accord with present-day psychology and the established facts of localization in the brain. The progress of investigation takes us farther away from sharply localized areas. See *PHYSIOLOGY OF BRAIN*.

J. J.

PHRYGIA, in ancient geography, a country lying in the western part of central Asia Minor. Phrygia

is culturally important in that some of the early Greek music originally came from this section. But the natives lost practically all intellectual qualities when they were conquered by the Persians in the 6th century B.C. and in Roman times they were commonly referred to as stupid and spiritless.

PHRYGIAN, an extinct INDO-EUROPEAN language preserved in a number of glosses and proper names, and in some 20 inscriptions in Old Phrygian and over 70 in New Phrygian, dating from the 6th century B.C. to the Roman period, and written in Greek letters. Its precise linguistic affinities are uncertain, but it belonged to the *satem*-group (see *SATEM-LANGUAGES*), and was perhaps most closely akin to Thracian, Illyrian, Messapian and Albanian (see separate articles on these subjects).

PHTHALIC ANHYDRIDE, a chemical produced as long needle-shaped crystals, was manufactured on a large scale abroad prior to the World War as an intermediate in the synthesis of INDIGO, the EOSINE dyes and PHENOLPHTHALEIN. It was made by the catalytic oxidation of naphthalene—a cumbrous and difficult process—using an excess of sulphuric acid as an oxidizer. Practically none was made in America. During the War, Wohl in Germany, and H. D. Gibbs and Courtney Conover at about the same time catalytically oxidized naphthalene to phthalic anhydride using the oxides of vanadium and related elements as the CATALYST. In America this laboratory process was “dedicated to the public” and adapted to commercial production by various chemical companies.

Since the War the annual U.S. production has grown to a present plant capacity of many million pounds. All of it is made by passing naphthalene vapor and air continuously into contact with a catalyst, whereby phthalic anhydride is formed instantaneously and continuously passes on into a condensing chamber in which it separates from the fixed gases. This is distinctly an American achievement. None of it is used in the synthetic indigo industry, but is employed in the synthesis of ANTHRAQUINONE and its derivatives, in the production of plasticizers for LACQUERS, in the production of BENZOIC ACID, and in the production of the glycerine-phthalic RESINS.

C. R. D.

PHYFE, DUNCAN (1768-1854), American cabinet-maker and furniture designer, was born in 1768 at Loch Fannich, near Inverness, Scotland. He came to the United States in 1783 or 1784 and learned the cabinet-maker's trade in Albany. Moving to New York City in 1790, he set up shop on Partition Street, at what is now 168-172 Fulton Street. Mrs. Langdon, daughter of John Jacob Astor, was the first to appreciate the genius of Phyfe, and through her influence he became the cabinet-maker of an exclusive clientele in New York. Before he was thirty he was established as the fashionable cabinet-maker of the entire country.

Phyfe furniture may be classified in three definite periods. From 1795 to 1818 the designer was under

Adam-Sheraton influences and produced his finest work. From 1830 to 1847 he worked under Empire influences. Lastly, from 1830 to 1840 was the period of heavy black walnut and rosewood, which Phyfe himself classified as “Butcher Furniture.”

Phyfe specialized in chairs, sofas and tables. Sweeping curves of exquisite proportion were characteristic of his work. The lyre motif, finely carved and with strings of brass or whalebone, was a favorite detail. Other characteristics were the acanthus pattern, reeding, ornamental brass hardware and inlaid panels of crotch mahogany veneer. Phyfe was a master in working mahogany to bring out a maximum of texture and color. In his earlier periods he used mahogany exclusively, importing it himself from Cuba and Santa Domingo and paying as high as \$1,000 for single logs. Duncan Phyfe died a wealthy man, Aug. 16, 1854, at New York City.

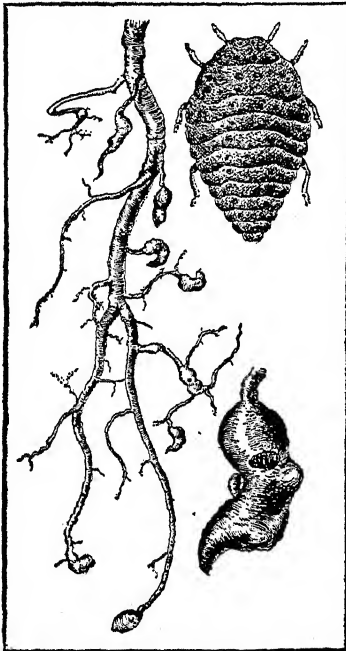
PHYLACTERIES (Hebrew, *Tefillin*), leather praying-slips with little leather square boxes attached to them, which are worn by male Jews every morning, except Sabbath and holy days, during the morning service either in the home or in the synagogue. A set of the Tefillin (a term derived perhaps from the Hebrew word *tefillah*, “prayer”) consists of two parts, the phylactery of the hand, and the phylactery of the head. In Talmudic days the rite of wearing the phylacteries was not generally observed among the teachers and rabbis, and was practically unheard of among the general population.

PHYLLITE, a METAMORPHIC ROCK derived from either SEDIMENTARY or IGNEOUS rocks. Phyllites are white, through yellowish and greenish, to black in color, and usually feel slightly greasy. They contain large amounts of mica, variety sericite, with considerable quartz, and are intermediate between SLATES and mica SCHISTS. The name, meaning “leaf stone,” is given because of their fine cleavage, permitting them to be split in very thin pieces. See also PETROLOGY; METAMORPHISM.

PHYLLODE, a flattened or expanded, leaf-like petiole, the true leaf-blade being absent or vestigial. Phyllodes function as leaf-blades, occur in various groups of plants, and are particularly abundant in arid climates. They are especially well-developed in many species of acacia, natives of Australia but often cultivated in the warmer parts of the United States.

PHYLLOSPERMS, a name applied by paleobotanists to plants bearing naked seeds directly upon their foliage, as in extinct seed ferns abundant in the Coal Measures, or on leaflike scales, as in living cycads. The term distinguishes these plants from a second division of gymnosperms (Stacyosperms) in which the seed develops on a modified stem, as in the ancient catkin-bearing tree, Cordaites, living conifers, and ginkgoes. A common origin is generally assumed for these two divisions. Owing to the often indistinguishable characters of the seeds, with marked anatomical affinities, authorities differ as to how far divergence in fruiting habit should separate these two groups.

PHYLLOXERA, any insect of the subfamily *Phylloxerinae*, order *Homoptera*. The wingless females are covered with a waxy powder which they excrete, thus resembling mealy-bugs. Several species infest hickory, oak and chestnut trees. On hickory they form galls on twigs or leaves. Other species are found on poplar, willow and sour-gum. The most familiar insect of this group is the very destructive *Phylloxera vastatrix*, native to the eastern United States where it is seen on wild grapes. It is very injurious to European grapes, both in Europe and in America. Galls are produced on the leaves. More injurious are gall-like swellings on the roots. This phylloxera has a very complicated life



COURTESY U.S. DEPT. OF AGRICULTURE

PHYLLOXERA

Nodosities caused by P. on grapevine root, Adult P., and nodosity showing P. feeding (lower right)

history, taking two years for its completion. Wingless, sexless stem-mothers which produce many generations of similar females give rise in autumn to nymphs which migrate to the roots. Here they hibernate. In spring eggs are laid which produce winged males and sexual females. Eggs laid by this generation produce the wingless stem-mothers again. These live in the galls on grape leaves. The best control is the grafting of European grapes on resistant roots of American varieties. J. R. T.

PHYLOGENY, the ancestral history of any race of animals or plants. It is usually worked out by studying the fossil remains of a particular group through geological formations known to have been laid down in successive periods. Both comparative anatomy and embryology often shed light on the phylogeny of a group of animals or plants. See ORGANIC EVOLUTION. G. K. N.

PHYLUM, in taxonomy, a primary division of the animal or vegetable kingdom. It is about the equivalent of the formerly used subkingdom. The phyla of the vegetable kingdom are as follows, proceeding from the simpler to the more complex: Schizophyta or fission plants, some with chlorophyll (fission algæ), the Schizophyceæ, some without chlorophyll (fission fungi, or bacteria), the Schizomycetes; Thallophyta or thallus plants, including the algæ, fungi, and lichens; Bryophyta or mosses, including true mosses and the liverworts; Pteridophyta or ferns, including the true ferns, horsetail rushes (*Equisetum*), ground pines, club mosses and allies; Spermatophyta or seed plants (commonly called flowering plants). Another group, the Myxomycetes or slime molds, regarded now usually as plants, but formerly regarded as animals, is now usually included among the Thallophyta, but, according to some botanists, should form a phylum (*Myxophyta*) below Thallophyta.

The phyla of the animal kingdom are the following: 1. Protozoa, unicellular animals; 2. Porifera, sponges; 3. Cœlenterata, polyps and jellyfishes; 4. Platyhelminthes, flatworms; 5. Nematelminthes, roundworms; 6. Trochelminthes, wheel animalcules; 7. Molluscoida, brachipods and polyzoans; 8. Echinodermata, starfishes and sea urchins; 9. Annulata, annulated worms (including earthworms and leeches); 10. Arthropoda, insects, crustaceans and allies; 11. Mollusca, mollusks; 12. Chordata, vertebrates and allies.

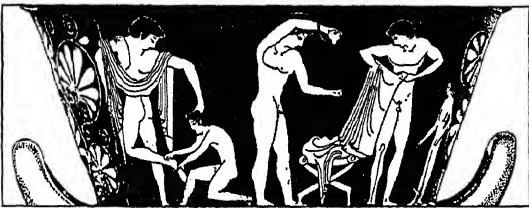
A. S. H.

PHYSICAL MEASUREMENTS, in athletics, comprise that class of dimensions of the limbs, organs and other parts of the human body, taken to ascertain an athlete's general well-being, and particularly his immediate fitness for a given test of endurance. In a broad sense, such physical measurements are a part of anthropometry. Coincident with the progress of physical culture, dating from the middle of the 19th century, physical measurements have been recorded at most schools and universities, with the aim of determining an accurate index to health. To this end a variety of measuring instruments are employed. Chief among them are the weighing machine and the stadiometer, the latter for measuring height. Other instruments ascertain circumferential measurements of the chest, girth, biceps, etc. Calipers are sometimes used to obtain the depth of the chest and abdomen. The dynamometer measures the muscular reactions, and the spirometer gauges the lung capacity. Before an athletic event requiring unusual stamina, as a prizefight or 100-yard dash, the heartbeat and blood pressure of participants are measured by a doctor. See also PHYSICAL TESTS.

PHYSICAL TESTS, in athletics, the critical examination of the vital organs and other parts of the human body, to determine (1) the mean, average, or normal status of a student or athlete, and (2) an athlete's fitness to withstand the strain of a given athletic event. In the first category, such tests are primarily designed to group students into related physical classes, irrespective of their educational grade.

These tests are common to-day to all schools and gymnasiums, and in America certain states have passed statutes providing for such examination. In the second category, physical tests are made to guard against insensible weaknesses in the athlete which under strain might result in bodily injury. The two chief tests are made with the stethoscope, to determine the auscultation of the heart, and the sphygmomanometer, to determine blood pressure. Other tests are frequently made of the eyes, ears and lungs. The reflex action of the body is also tested to determine the state of the nervous system, more particularly the degree of sensitivity of the afferent nerves. *See also* PHYSICAL MEASUREMENTS.

PHYSICAL TRAINING, as we know it to-day, can be traced back directly to the Greeks and the Spartans. The former worked for the ideal of phys-



COURTESY M. M. OF ART

GREEK ATHLETES IN THE PALAESTRA

A typical scene painted on a krater. One youth has taken off his himation and is preparing to rub his body with oil from a flask which hangs from his wrist; another holds his himation; a third is balancing himself while an attendant draws a thorn from his foot.

ical perfection; the latter knew that if their group was to survive every man must be in perfect condition. The Romans adopted the gymnastics of the Greeks, though their military training more closely approximated that of the Spartans. Religious fanaticism in the Middle Ages, with the accompanying belief in the mortification of the flesh, naturally halted the advances made by the pagans in physical training. The Renaissance brought about a revival of interest, particularly after the writings of the famous educators, Locke and Rousseau. The greatest urge for physical training came from the Germans and the Swedes in the early part of the 19th century. Popular gymnastics were promoted in Germany by the famed FRIEDRICH LUDWIG JAHN in 1809. Adolph Spiess brought the gymnasium into the German School not long afterwards. Per Henrick Ling, famous Swedish gymnast, was the leader in physical training at Stockholm. His methods were used at the Royal Central Institute of Stockholm. The Ling System was introduced in England in 1838 by Lt. Govert Indebeton, and since then has spread to most of the countries of the world.

The groups of physical training found in Europe can be classified as: the gymnastic societies, the athletic sports and active games of the schools and universities, and the school gymnastics. Corresponding to these there have been organized the Federation Games of the Gymnastic Societies, the OLYMPIC GAMES, and a number of congresses established for

the purpose of promoting physical training. The latter three groups are of an international character. They have done much in the past for the growth of physical training, and there is still a great deal to be hoped for from them in the future.

Military drill and physical education have been important in the curriculum of West Point since 1812. Follen and Beck were the first to introduce the Jahn gymnastics to the United States. The first gymnasium established in the United States was at the Round Hill School in 1823. It was followed by the first college gymnasium at Harvard, and by the Public Gymnasium at Boston, in 1826. Dr. Dio Lewis opened the Normal Institute for Physical Education in 1861 at Boston, where he introduced his "new gymnastics" for men, women and children. It was not long before all colleges had gymnasia. Yale, Amherst, Williams, Brown, Bowdoin, Dartmouth and Princeton soon followed the lead of Harvard. Rowing was one of the first sports taken up by the American colleges. Yale and Harvard had their first regatta in 1826. Baseball began in about 1856 at Amherst, Princeton and Yale. Football of an intramural nature existed before 1869 and gradually became intercollegiate. The Caledonian Games of the Scotch immigrants led to the formation of the Caledonian Clubs in 1853, thus beginning track athletics. Columbia University was the pioneer in this sport, and other colleges soon took it up. At the Saratoga Meet in 1875 there were represented 10 of the leading universities. Athletics in general were greatly advanced by the formation of athletic associations at the majority of the colleges. The World War emphasized the need of physical training in the schools, and 1915-31 laws prescribing this training for public schools had been passed by 30 states, only three states having passed such laws before 1915. In universities physical training is required for at least one year.

Physical training has been developed in other than purely educational institutions. The German-American Societies of 1848 did much for its advancement, and the same is true of the Young Men's Christian Association since 1867. City and state legislatures have also worked in the same direction. The cities are developing playgrounds everywhere. Many municipal playgrounds are found in the cities of Chicago, New York and Philadelphia, where the need for them is the greatest.

Physical training as it is known to-day does more than develop pure physical prowess. The members of teams and classes are made to realize the importance of cooperation and loyalty. Sport for sport's sake is as widely cultivated as sport for individual glory. Games that bring about personal contact and individual competition develop initiative. This was well illustrated in the World War. The Americans and the British who had had experience with that type of physical training were outstanding in the close quarter conflicts. Germany and her allies had had experience almost entirely with the mass athletics, and were at a great loss because of their lack

of initiative. Since the war the Germans have sought to rectify their mistake of the past and have provided more individual training. Greater confidence in oneself and poise are brought about by active physical training. See HEALTH EDUCATION. L. R.

PHYSICAL UNITS. All physical quantities may be measured in terms of length, mass and time. These are *fundamental units*, and will be designated, respectively, by the letters *L*, *M* and *T*. In the METRIC SYSTEM, these units are called the centimeter, gram and second, and are known as the c.g.s. system. In the English system, the foot, pound and second are the fundamental units, and are called the f.p.s. system. To illustrate how physical quantities may be expressed in terms of these three fundamental units, consider VELOCITY as a physical quantity, thus

$$\text{velocity} = \frac{\text{length}}{\text{time}} \text{ or } V = \frac{L}{T}$$

From these equations it is seen that velocity is expressed in terms of length and time. In the metric system, this would be in terms of centimeters per second. In the English system, it would be in feet per second. Take another illustration, viz., acceleration,

$$\text{acceleration} = \frac{\text{velocity}}{\text{time}} = \frac{\frac{\text{length}}{\text{time}}}{\text{time}} = \frac{\text{length}}{(\text{time})^2} = \frac{L}{T^2}$$

Again take force as an illustration.

$$\text{force} = \text{mass} \times \text{acceleration} = \frac{ML}{T^2}$$

Turning next to physical quantities which are not primarily mechanical, consider electricity. The forces between electrical charges may be stated as follows:

$$\text{force} = \frac{\text{electric charge}_1 \times \text{electric charge}_2}{(\text{distance between charges})^2}$$

$$\text{or } F = \frac{e_1 e_2}{d^2} = \frac{ML}{T^2}$$

when the value given above for *F* is substituted:

$$e_1 e_2 = \frac{ML^3}{T^2} \text{ and } e = \frac{M^{1/2} L^{3/2}}{T}$$

Thus, an electric charge may be expressed in terms of length, mass and time, as well as any other physical quantity. This is also the same as expressing a physical quantity in terms of *dimensional units*. In an equation involving several physical quantities, these units may be expressed dimensionally, and, if the equation is not true dimensionally, neither will it be true physically. Also, dimensional units help to give names for physical quantities. The unit of velocity has had no special name given to it, so it is called centimeters, or feet, per second.

A great deal of confusion would arise if each country established its own units of measurement. Consequently, the civilized countries have adopted certain units, called *standard units*, as the ones on which to base the fundamental units of length, mass and time. For the standard of length in the metric system

there is preserved in the INTERNATIONAL BUREAU OF WEIGHTS AND MEASURES at Sevres, near Paris, a platinum-iridium bar with a mark at each end. The distance between these two marks, when the bar is at a temperature of 0°C., is defined as the standard of length and is called the meter. This bar has also been measured in terms of WAVE-LENGTHS of light, so that it may be duplicated with a very high degree of accuracy if it should ever be destroyed. The various countries of the world have also established duplicates of this bar, called prototypes, which are preserved in their respective bureaus of weights and measures. The international standard of length was originally established as one-ten-millionth of the earth's quadrant, but after the bar had been made, it was found that the earth's quadrant had not been measured accurately, and the standard meter was decreed to be the distance between the marks established on the original bar. The meter is subdivided into decimeters, centimeters and millimeters. Multiples of it are called dekameters, hectometers and kilometers. In a similar fashion, the standard unit of mass was established. It was originally designed to represent the mass of 1,000 cu. cm. of pure water at 0° C. Later, this was found to be not quite correct and, by official decree, the original platinum-iridium mass was declared to be the standard unit of mass and called the kilogram. The kilogram is subdivided into hectograms, dekagrams, grams, decigrams, centigrams and milligrams.

The standard of time is called the second. It is the 1/86,400 part of the mean solar day. The time it takes the earth to rotate on its axis, i.e., from the time the sun appears to cross the meridian until it crosses it again, is called the solar day.

In the English system, the yard and the pound were arbitrarily established as the standard units of length and mass, respectively. The yard is subdivided into feet and inches, there being three feet to the yard and 12 inches to the foot. The pound is subdivided into ounces, there being 16 ounces to the pound in ordinary weighing (see AVOIRDUPOIS WEIGHT).

The common conversion factors between the metric and English systems are: 1 inch = 2.54 centimeters; 1 pound = 0.454 kilograms, approximately; 1 meter = 39.37 inches.

While all physical quantities may be expressed in terms of the fundamental units, special units are generally defined for measuring special physical quantities. Thus, in measuring an electric current, the ampere has been adopted as the *practical unit*. The electric current could be expressed in terms of the fundamental units, but it is more convenient to use the practical unit. This is true for most physical quantities. See also UNITS, ELECTRICAL; MAGNETIC UNITS. S. R. W.

PHYSICIAN. The training of the physician is now universally regulated by law. In the United States an aspirant to the practice of medicine must, after the completion of a high school course, take a premedical collegiate course of at least

two years. During this time he is grounded in zoology, comparative anatomy, chemistry, physics and languages. Then he must complete a four-years' course in a recognized medical college. During the first two years he studies anatomy, physiology, biochemistry, bacteriology and pathology. The last two years are spent on the clinical subjects. He is assigned to various special services and studies actual cases at the bedside. The clinical work is supplemented by lectures, reading and topical writing in the various branches. At the end of this period he is eligible to take a state or a national board examination. Almost universally, however, before this examination he resides in a hospital for a year as an interne, studying cases and assisting in medicine and surgery.

At present practically all of the medical colleges in the United States are of a class A rating. Class A colleges, however, differ considerably among themselves, depending on the character and extent of clinical material, reputation of the faculty, standing as a research institution, educational standards and character of student body.

Though most doctors are engaged in general practice as both physician and surgeon, there are a number of specialized fields. An internist treats internal diseases, an Oculist treats diseases of or injuries to the eyes, a urologist treats diseases of the urinary and male generative organs, a gynecologist treats diseases of the female generative organs, an obstetrician assists at childbirth, a dermatologist treats diseases of the skin, a neurologist treats diseases of the nervous system, a psychiatrist treats diseases of the mind and a surgeon treats injuries or diseases requiring manual operation or mechanical aid.

PHYSIC NUT (*Jatropha Curcas*), a shrubby tropical American tree of the spurge family called also Barbadosnut. From the white, solid kernels of the small oblong nut is extracted a purgative oil, called curcas oil, used in medicine and also for illumination. The tree is sparingly grown for ornament in the warmer parts of the Gulf states.

PHYSICS, a study of mechanics, sound, heat, light, electricity and magnetism (*see* separate articles on these subjects). Primarily, physics is concerned with **ENERGY** and with **MATTER** as the vehicle of the energy transformations which are continually going on in it. The energy transformations which go on in the processes of life are physical. The same holds for chemical processes. Wherever energy transformations are going on, there physical concepts are needed for a complete understanding of what is taking place. More and more the methods of physical measurements are being applied in the biological sciences. It is for this reason that physics is one of the outstanding requirements for students entering medical colleges. Physics enters so largely into everyday life that it is important for everyone to have some knowledge of the subject.

S. R. W.

PHYSIKALISCHE TECHNISCHE REICH-ANSTALT, the national standardizing and research

laboratory of Germany, founded in Berlin in 1887. Its duties are practically the same as those of the NATIONAL BUREAU OF STANDARDS and the NATIONAL PHYSICAL LABORATORY which were, in fact, patterned after it. This was the first important laboratory in which problems bearing directly on science in industry might be solved. Its work on scientific instruments following its foundation was so great that it had the effect of boosting Germany to the position of supremacy in the manufacture of instruments, putting the German industries ahead of those of France and England which had formerly excelled in the quality of their product. The Physikalische Technische Reichsanstalt is larger and more thoroughly equipped to serve the needs of its country than are either the National Bureau of Standards or the National Physical Laboratory.

PHYSIOCRATIC SCHOOL, an organization which came to its height in 18th century France. It is distinguished as a whole on two grounds: that of being the first school of economists, and that of being the first economists to formulate an economic system. The school was founded by F. QUESNAY, a doctor, and its best known members were DU PONT DE NEMOURS and A. R. Turgot.

The physiocratic system included three basic ideas: the existence of a natural or providential order, which was known by intuition, and which was to be established by the state and taught by it to its citizens; the theory that land, and land alone, produced a surplus (*produit net*) above the subsistence of its cultivators, which supports the other two unproductive classes, the proprietors and the artisans; and the concept of a system of distribution, or circulation of wealth, analogous to that of the circulation of the blood. The surplus of the cultivators was distributed to the proprietors and the artisans, who in turn sent it back to its source by exchanging it for both agricultural and manufactured commodities. Exchange was therefore a circular process originating and ending in the cultivation of the land.

Certain similar ideas are found in ADAM SMITH, many of them developed independently. From the physiocrats, however, came his belief in the superior productivity of agriculture. The physiocratic doctrine of a net surplus or rent arising from the superior fertility of land was opposed by DAVID RICARDO's theory of the niggardliness of nature, or the scarcity of fertile land, as the source of rent. E. W. G.

BIBLIOGRAPHY.—Gide and Rist, *History of Economic Doctrine*.

PHYSIOGNOMY, a system of reading character traits in the lines of the face and in the body generally. In the ancient Greek form it proceeded upon such general associations as that of courage or timidity with color, texture of hair, or shape of nose; or it used animal analogies ascribing the qualities of an eagle, sheep or lion to one whose head resembled slightly that of the animal. In course of time the relations were made more detailed and fanciful. Physiognomy came under the influence of **ASTROLOGY** by

dividing the lines of the forehead and face among the planets and interpreting character traits accordingly.

Physiognomy continued as a rather weak and casual human interest until its revival by Lavater (1741-1801), who developed it minutely. A clergyman well acquainted with many persons, and a good artist, he was in a favorable position to draw the features and interpret them. The same method was applied to the features of the great men. Lavater traced in every feature of the head of Voltaire the signs of great wit and satire. He relied on an impressionistic sense and laid down rules for associating certain shapes of brows, noses, mouths, ears and chins, with ambition, benevolence, firmness, temper, sensuality and so on.

Physiognomy illustrates how readily a prejudiced but able mind can become convinced of generalizations that have only subjective evidence. In the hands of quacks physiognomy was practiced along with other forms of character reading and rapidly degenerated to the level of such systems. That there is a scientific study of the relations of physique or bodily traits, and temperament, or tendency toward mental and emotional traits, is clear; but it proceeds by quite other methods and is content with general correlations, to be cautiously applied to individual cases. Generalizations in regard to the character traits of blondes and brunettes, of long heads and round heads are quite unreliable as applied to the individual; they retain an interest in the descriptions of racial characteristics. See ANTHROPOLOGY.

J. J.

PHYSIOGRAPHY, freely defined, is the study of man's physical environment. In the expansion of the science to include man's relation to this physical environment as suggested by the first and foremost physiographer of America, William Morris Davis, in one of his essays upon the physical geography of the lands, two distinct phases of the subject immediately arise; geomorphology, concerned strictly with the description and explanation of the form of the earth, the distribution of land and water, the general configuration of the surface, the agencies and processes by which the land and water forms are modified, and anthropogeography, concerned with the character and distribution of races and peoples, and their activities, and civilization and culture with their variations. To these might be added a third, biogeography, similarly concerned with the character and distribution of floras and fauna.

Physiography, or at least that phase of the science designated geomorphology, may also be described as current geology, the investigation of the earth and its surface features in the making. As such it would have to do with surface of the *lithosphere*, or the solid part of the earth; the *hydrosphere*, or water envelope of the earth; and the *atmosphere* or air. The science which deals exhaustively with the air, however, is *Meteorology*; the science which develops the subject of water is *Hydrography*, and of the waters of the ocean, *Oceanography*, the complete science concerned with the lithosphere is *Geology*, which in its broadest sense includes all the others. Thus

the field of physiography, or, in the strictest application of the term, of geomorphology, is the zone of contact between air and water with land, and between air and water.

Physiography has been ably developed in America under the leadership of two outstanding educators, William Morris Davis of Harvard University, and the late Rollin D. Salisbury of the University of Chicago, whose inspiring teaching and training sent a small army of highly capable investigators into the field to do brilliant scientific work. The first vigorous impetus in America to the critical field study of geomorphology was undoubtedly given by Major J. W. Powell, whose studies of river erosion in the basin of the Colorado River of the West and its tributaries, furnished W. M. Davis the basic concepts upon which to develop his justly famed "cycle of erosion," whereby rivers and their work could be scientifically classified. This concept, established so ably by Davis and presented so clearly by him and Salisbury, has been fully supported by the distinguished field work of such American masters as T. C. Chamberlin, Grove K. Gilbert, I. C. Russell, C. E. Dutton, D. W. Johnson, J. E. Spurr, J. S. Diller, Eliot Blackwelder, Wallace W. Atwood, R. S. Tarr, B. K. Emerson, and others contemporary to them or following them, too numerous to mention. American research workers in physiography have led the world in that science for many years.

In many schools in England, physiography is regarded as introductory to all general sciences, biological sciences as well as the earth sciences. The Scotch and British have done fine field work. In France physiography has been more concerned with detailed morphologic studies of small regions than with broad general principles. In Germany physiography has been generally subordinated to human geography or anthropogeography. In Switzerland a highly capable corps of physiographers, stimulated by the complexity of local land forms and widespread glaciation, have made profound studies of mountain and valley-sculpture, and the effective work of stream, wind and glacier. Alpine physiography, like Alpine geography, has flourished.

Since the World War general interest in physiography has waned, but renewed zest in the interpretation of the morphology of physical landscape is manifest in all the civilized lands; and in America an able staff of younger workers in the field, including Kirk Byran of Harvard University, R. E. Flint of Yale University, Ernest Antevs of the Canadian Geological Survey, and others, are opening up new fields of investigations.

W. E. E.

BIBLIOGRAPHY.—W. M. Davis, *Geographical Essays*, 1909; R. D. Salisbury, *Physiography*, 1907.

PHYSIOLOGY. The science of physiology deals with the *rôle* or *function* which any organ or structure performs in the life of any individual plant or animal. The physiologist is, therefore, concerned in what the different parts of plant and animal do and how they do it.

If a complicated man-made machine was found, the inquisitive finder would take it apart with such tools as were available. He would describe each major part so accurately from point of view of size and structure, as well as its relationship to other parts that any artisan could, on the basis of these measurements, reconstruct an exact duplicate without knowing in the slightest degree what work the machine performed when in action or how the work was performed, unless certain parts bore so close a resemblance to certain parts of a modern machine of known performance that its office in the hypothetical machine would be susceptible of some more or less well founded conjectures.

Historically considered, man, the "microcosm," found numerous "machines" about him on the "macrocosm" on earth, with various shapes in the form of plants and animals. On even cursory inspection these various forms of life had various parts, some of which resembled those of other living forms, some of which were totally different in their gross and microscopic architecture. The science of describing the various forms and parts thereof (as tissues and organs) constitutes *descriptive anatomy* (see ANATOMY), or if in comparison with other forms, COMPARATIVE ANATOMY.

At a later date, man's frame was also anatomized; and certain conjectures were made as to the probable rôle or function played by this or that organ in the life of the individual. Noting the resemblance of certain structures possessed by man and also present in many of the higher animals (such as monkey, cat, rabbit, dog), scientists began to investigate the rôle of the individual organs in the living animal, on the hypothesis that the machine of the living body would *during activity* reveal the rôle played by the individual organs. This primitive attempt was, at the time, called *animated anatomy*. Thus was born the science of physiology which, on *experimental* grounds, attempts to assign a function to a living part, and then, by further *experimental work and analysis* on the living animal, attempts to show how the organ does its job.

Obviously, the performance and effectiveness of a man-made machine is best evaluated when in action. One can observe its fuel intake and its output in useful and waste products. Similarly, the machine of the body is studied most advantageously when it is in activity. Furthermore, if certain parts in the lower animals, as organs, are known on experimental grounds to do this or that, depending upon the conditions of the experiment, and if their organs are identical with those possessed by man, useful information is obtained in aiding the physician to direct his ward, the patient, to so conduct himself that each and every part of his body continues to perform its offices normally. Obviously such useful information can be obtained only if those qualified to conduct experiments will be permitted, in the future as in the past, to experiment on living organisms.

(1) *General Physiology*. The physiological unit of

all living forms is the *cell*, consisting of a more fluid portion spoken of as the *cytoplasm*, in which appears a smaller, more solid spherical structure known as the *nucleus* (see CYTOLOGY). The cells which constitute a given organ or tissue differ in arrangement, size, reaction to various dyes, disposition about blood vessels, etc. However, they are all composed of more or less simple or complex chemical compounds, such as carbohydrates, proteins, fats, inorganic and organic salts, and water. When these substances are in proper physical and chemical relationship to each other, the mass has all the attributes of life. The general physiologist studies the attributes of their living matter (fermentation, production of heat, irritability, contractility, etc.), using freely plant and animal cells for his purpose.

(2) *Animal Physiology*. In this science the experimenter restricts his activities to a study of the animal organism. The subdivisions of the field are purely arbitrary and indicate solely the chief direction of endeavor of the individual investigator. As a result we speak of the *comparative physiology of the vertebrates or invertebrates* or of *human physiology*. Most of the facts known about the mode of action of human organs in health and disease were obtained from a study of similar organs of the lower animals.

(3) *Plant Physiology*. A botanist who is interested more in what the different parts of different plants do than what they look like or to what division of the plant kingdom they belong (taxonomy), is spoken of as a plant physiologist. See PLANTS: Physiology.

A. B. L.

PHYSIOLOGY OF PLANTS, that phase of botany which is concerned with a study of the functions of the various organs and the behavior of living plants. Processes are explained with the support of the knowledge of physics and chemistry, and most phases of physiology can advance only as the knowledge of physics and chemistry advances. In addition to a knowledge of plants a physiologist must be a specialist also in other fields. Of particular value for an understanding of plant processes is a knowledge of organic chemistry.

Plants and animals are very much alike in respect to some phases of their physiology. The great difference appears in the capacity of the plant to manufacture organic food from inorganic elements and in the manner by which plants absorb water. The utilization of food is similar. For example, starch is digested in the mouth of an animal by diastase, an enzyme of the saliva; plants digest starch with the same type of enzyme but it is secreted by the protoplasm of many different cells. Different types of enzymes are necessary for digestion of different food. The animal has special organs for supplying these enzymes (diastase from glands of the mouth and pepsin from the stomach), whereas these enzymes may be secreted somewhat generally by plant protoplasm. New protoplasm can be assimilated in both by the utilization of simple organic compounds and the energy from respiration.

For additional information on subjects related to plant physiology *see* PLANTS, Physiology; PHOTOSYNTHESIS; PROTEIN; PROTOPLASM; RESPIRATION; METABOLISM; ENZYMES; STARCH; SUGAR; GROWTH; and OSMOSIS.

P. W. Z.

PI (π). The ratio of the circumference of a circle to the length of the diameter of the same circle has the same numerical value no matter what the size of the circle considered may be. This ratio is therefore of the nature of a universal constant, like, say, the constant of GRAVITATION. This constant is usually denoted by the Greek letter π (p_i). Contrary to a widespread belief, even among professional mathematicians, this symbol is of rather recent origin. It first appeared in the 17th century, and in the present sense it was not used until early in the 18th century. The favor this symbol found with EULER finally made it popular.

The ancient Chinese, over a thousand years B.C., are said to have taken this ratio π to be 3. So did the writers of the Old Testament, of about the same period (I Kings, VII, 23). The Egyptians used $(16/9)^2$ and the Hindus used $\sqrt{10}$. With the invention of decimal fractions (*see* DECIMALS) and the perfecting of the methods of arithmetical computation, the value of π was found with greater exactness. Thus Ludolph van Ceulen (1540-1610) found π correct to 35 decimal places, and tradition says that he had this number put on his tombstone in Leyden. A century later infinite series giving the value of π were found in connection with the study of the newly invented differential and INTEGRAL CALCULUS. Thus Wallis and Leibnitz gave, respectively, the series

$$\frac{\pi}{2} = \frac{2}{1} \cdot \frac{2}{3} \cdot \frac{4}{3} \cdot \frac{4}{5} \cdot \frac{6}{5} \cdot \frac{6}{7} \dots$$

$$\frac{\pi}{4} = 1 - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \frac{1}{9} - \dots$$

At present more than 700 decimal places of π are known. The first ten of them are given in 3.1415926535.

Our knowledge as to the intimate nature of the number has been acquired only in recent times.

Liouville (1844) was the first to prove the existence of TRANSCENDENTAL NUMBERS, i.e., numbers which are not roots of any algebraic equation with rational coefficients. Charles Hermite (1873) proved that the number e (*see* LOGARITHMS) is such a transcendental number. By a skillful adaptation of Hermite's proof, Lindemann (1882) showed that π is also a transcendental number.

The number π is intimately connected with the famous problem of squaring the circle, that is, constructing a square equal in area to the area of a given circle. Such a square could readily be found if we could construct a rectangle having one side equal to half the circumference, and the other to the radius of the circle. If the radius is taken for the unit of length, the latter problem amounts to the construction of a line equal in length to $\frac{1}{2}\pi$. Now, due to the

transcendental nature of π , it is not possible to construct such a line not only with ruler and compasses, as the problem is commonly understood, but even with compasses drawing any kind of algebraic curve (*see* CURVES). It can, however, be solved with compasses drawing transcendental curves, as for instance $y = \arcsin x$. The integrator of Abdank Abakanowicz may serve such a purpose.

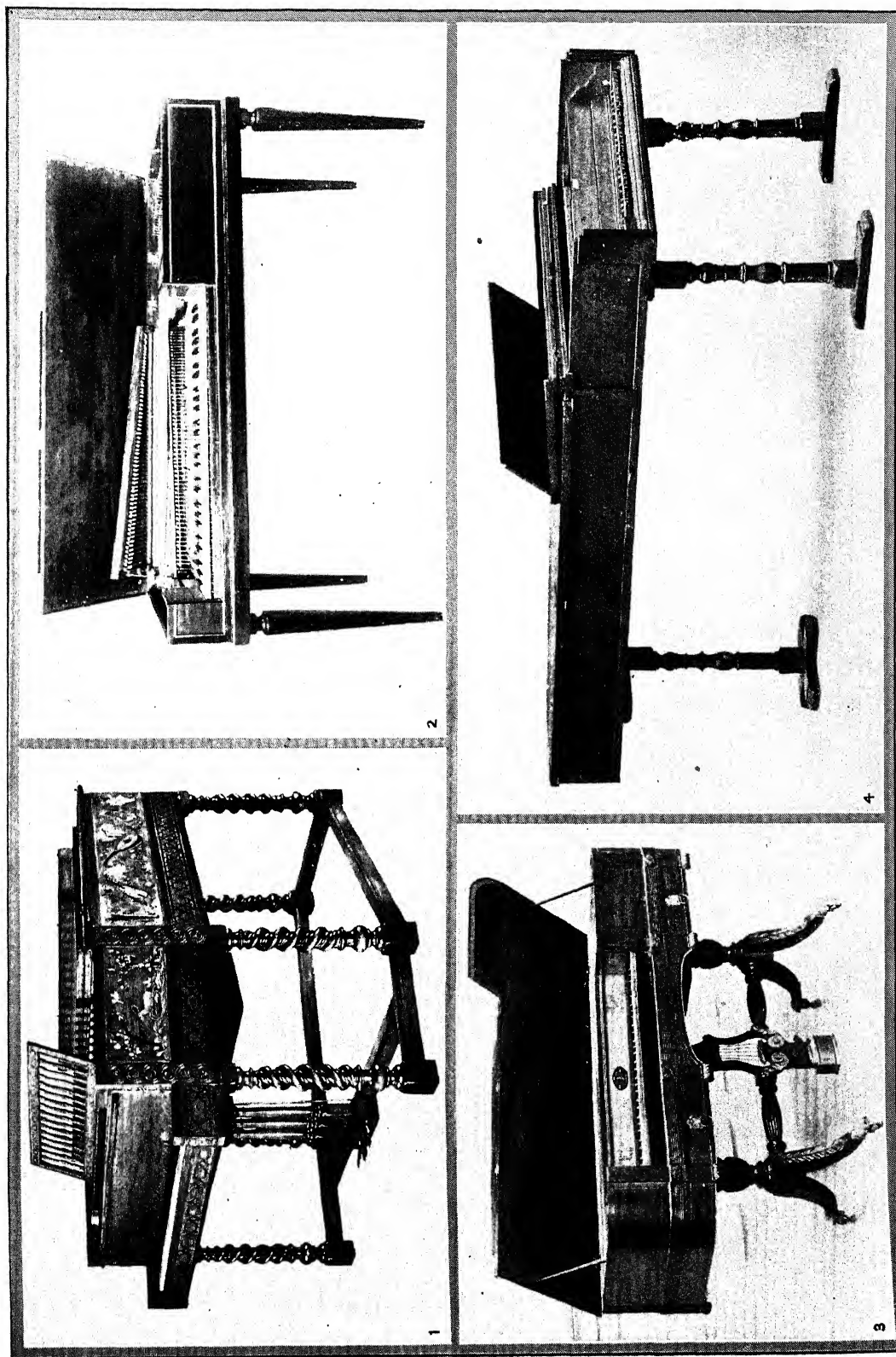
N. A. C.

PIACENZA, the capital of the province of the same name in north central Italy near the confluence of the Po and the Trebbia. It is surrounded by walls pierced by 11 gates. The city has wide, regular streets with fine squares and an interesting Palazzo Municipale, a Gothic building of the 13th century in the Piazza dei Cavalli, so called from the equestrian statues of Alessandro and Ranuccio Farnese. The cathedral, with fine frescoes, is of the 12th and 13th centuries. Noteworthy are also the Gothic church of San Francesco, 1278; the former 11th century cathedral of San Antonio, frequently restored; and the church of San Sisto, a fine Renaissance building of 1499, once glorified by Raphael's Sistine Madonna, now replaced by a copy. Of the palaces, that of the Farnese family is interesting though uncompleted. The ancient *Placentia*, Piacenza was the capital of a county in medieval times; two ecumenical councils were held here under Urban II and Innocent II, 1095 and 1132. The city changed hands frequently, and fell to the Visconti in 1313, in 1512 to the Papacy, and 1545, as a duchy, together with Parma, to the Farnese. The chief pursuit of the region is agriculture; the city's industries are the manufacture of machines, automobiles and various other commodities. Piacenza is also the seat of the most important Italian agricultural association. Pop. 1931, 65,750.

PIANKASHAW, a North American Indian tribe speaking a dialect of the Algonkian linguistic stock. They were at one time a sub-tribe of the MIAMI. According to Chauvignerie (1736), the Wea, Piankashaw and Pepicokia were the same nation in different villages and numbered about 1,750. Until the beginning of the 19th century they lived in Indiana and Illinois, but they were gradually forced westward and a mere handful, none of pure blood, finally settled in Oklahoma, where with the other tribes with whom they had united they were known as the PEORIA.

PIANOFORTE, a stringed instrument with a keyboard embracing seven and a quarter octaves and, next to the modern pipe-organ, possessing the greatest compass in tone of any musical device. It includes two pedals; the left one for the purpose of softening the tone (*piano*) and the right one to sustain it (*forte*). There are two general styles of modern pianoforte; the grand and the upright. The keys for the player's fingers are continuations of horizontal strips of wood, faced with ivory or other material, resting on pivots with, in the upright piano, their ends impinging under the feet of a vertical row of 88 slender wooden shanks that form the handles of little "hammers" made of felt. These hammers face wire

PIANOFORTE



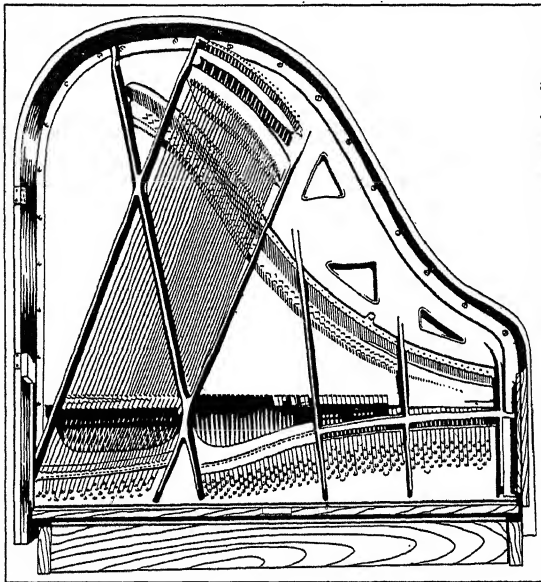
1. COURTESY THE AEOLIAN CO., NEW YORK; 2. 4. METROPOLITAN MUSEUM OF ART; 3. THE GALLERY OF FINE ARTS, YALE UNIVERSITY

PIANO DESIGN OF THREE CENTURIES

1. Modern grand piano with a harpsichord-like rim plane. The design is from an English table made about 1800 by Errard Frères et Cie.
3. Piano case by Duncan Phyfe, about 1815. Movement by Bartholomaeus de Christophorus, Florence, 1720.

strings stretched on a heavy metal, harp-shaped frame attached to the sounding-board at the back of the instrument. Pressing down a key automatically raises its impinging hammer-shank, the hammer falls forward, strikes the string and a tone results. Geared to each hammer and key with delicate nicety are complementary attachments such as tiny escapements, jacks, checks, set-off buttons, springs, leather hinges, bell crank levers, pivots and bushings which, with quality material and workmanship, perfectly govern and control the action and produce fine tone. The pedals are levers; the left one shifting the hammers closer to the strings, thereby softening the force of the blow, and the right one releasing a set of "dampers" that control the excess vibration of the strings so that sustained tones result.

With the grand piano, substantially the same mechanical system is employed except that the strings are



COURTESY THE AEOLIAN CO.

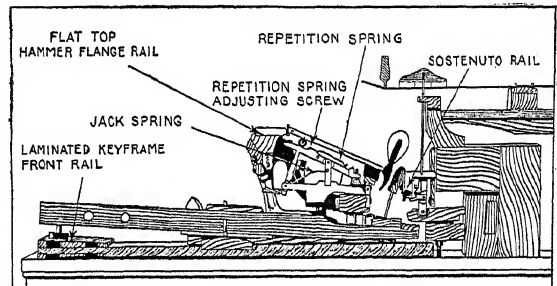
INTERNAL CONSTRUCTION OF A GRAND PIANO

strung horizontally instead of vertically and the hammers strike them from beneath, with an upward motion. All piano manufacturers employ skilled experts for the final assembling of the factory-made parts.

The modern piano is a descendant of the primitive clavichord which appeared in Italy around 1400 A.D. This earliest keyed string instrument had only a few notes and could be tucked under a minnesinger's arm. In Boccaccio's *Decameron* it is called a "cymbalo." By 1472, under various other names, more strings had been added. There was a chromatic keyboard, and in the 16th century the spinet attracted great favor in England and the Netherlands. In 1640 Jan Couchet of Antwerp invented the HARPISCHORD with two keyboards and during the 18th century these also became popular. But it remained for the great German composer, J. S. BACH (1685-1750), to devise equal TEMPERAMENT tuning and broadcast this important development through his book of contrapuntal pieces

called *The Well-tempered Clavier*. In 1766 Jacob Kirckmann and Burckhard Tschudi, who had settled in London, became famous there as great harpsichord-makers but the invention of the pianoforte must be credited to Bartolommeo Cristofori of Padua who, in 1709, produced keyed "psalteries con piano e forte," using the important principle of escapement, which is the controlled rebound of the hammer after it strikes the string. Seventeen years later he completed a better instrument, with all of the necessary action.

In 1783 it was shown that the Englishman, John Broadwood, who had drastically reconstructed the then existing square piano, had patented the first soft and sustaining pedals. In 1791 he improved the old 18th century grand piano and extended its compass to five-and-a-half octaves. The first satisfactory upright piano was invented in Philadelphia in 1800 by John Hawkins, also an Englishman, and with the growing importance of iron combined with wood in piano framing, and constant technical improvements, progress was rapid in all branches of piano manufacture.



COURTESY THE AEOLIAN CO.

ACTION OF A GRAND PIANO

Twentieth-century ingenuity devised the "mechanical" or player piano. Geared to a supplementary unit operated by pedal or by electric current, "rolls," which consist of the reproduced performances of a large group of pianists, may be played mechanically. Among modern American innovations is the so-called "breathing-piano" devised by John Hays Hammond, Jr., which is capable of sustaining sound vibration.

Composers of all nations have written for this instrument and the piano literature is, accordingly, enormous. The sonatas of MOZART and BEETHOVEN; piano compositions by such men as SCHUBERT, SCHUMANN, MENDELSSOHN, LISZT, CHOPIN, BRAHMS, GRIEG and DEBUSSY head the list, to which should be added an impressive amount of modern piano publications.

Besides the composers above mentioned, among the outstanding pianoforte virtuosi in history are ANTON RUBINSTEIN, IGNAZ PADEREWSKI, TERESA CARREÑO, Fanny Bloomfield Zeisler, SERGE RACHMANINOFF and HAROLD BAUER. Germany, England, France, Spain, and particularly the United States are rich in fine pianists, Italy seeming still to prefer the violin rather than the piano-virtuoso.

T. St.

BIBLIOGRAPHY.—E. Brinsmead, *History of the Pianoforte*, 1879; Alfred Dolge, *Pianos and Their Makers*, 1911; H. Westerby, *History of Pianoforte Music*, 1924.

PIARISTS, officially, Clerks Regular of the Pious Schools, a religious congregation for the free education of poor children, instituted at Rome in 1617 by St. Joseph Calasanctius. Under Pope Gregory XV, 1621, it attained the status of a religious congregation having solemn vows, and in 1622 was granted the privileges of mendicants; simple vows, however, were substituted in 1656. In 1931 more than 4,450 members conducted 344 schools, chiefly in European and Latin-American countries.

PIASTRE, a monetary unit used in Turkey and Egypt; also a nickel coin in Turkey worth about 4.4 cents and a silver coin in Egypt. It is one-hundredth of the Turkish and Egyptian pounds.

PIATIGORSK, a city in the North Caucasian Region of the RSFSR. It is situated on a plateau on the Podkumok River. The importance of the city is chiefly due to its large number of sulphur springs. Piatigorsk is also remembered as the place of the duel in 1841 that resulted in the death of Lermontov, the Russian poet. Pop. 1926, 40,723.

PICA, in printing one of the units of the POINT SYSTEM, equal to 12 points.

PICA, a perverted appetite, observed more often in young children during the first few years of life.

The habit manifests itself in the desire to eat a variety of unsuitable substances. The normal child soon learns by trial to discriminate between things good to eat and those which are inedible. The child with pica seems unable to distinguish and develops an unnatural appetite for such substances as dirt, sand, coal, ashes, soap, paper, wool, or even plaster.

Sometimes there is an unnatural taste for only one article; sometimes many varieties of peculiar substances are indulged in. The majority of children with pica are in good health; some suffer from digestive disturbances, malnutrition, anemia, intestinal parasites, or neuropathic constitution.

Pica developing in infancy may cease spontaneously as the child grows older. Occasionally the habit may continue longer and prove most intractable.

If the habit is not severe, the general health need not be impaired, though frequently there is a loss of normal appetite. Serious consequences may result, such as intestinal obstruction due to the impaction of hair, dirt and other indigestible objects; or lead poisoning may follow the eating of appreciable amounts of paint or enamel.

The treatment consists in watching these children closely and preventing them from obtaining the inedible substances they crave. A. F. A.

PICARDY, a former province of France, bounded on the west by Normandy and the English Channel, on the east by Champagne, on the north by Hainaut and Artois, and on the south by the Ile de France. The capital of Picardy was Amiens, and other chief towns in the province were Boulogne, Abbeville, Laon, Soissons, Montreuil, Peronne, Montdidier and St. Quentin. It was drained by the Oise and the Somme. The regional name was first used in the 13th century, and is sometimes said to have been derived from

pique, denoting the irascible character of the inhabitants of northeastern France. In 1167 Philip of Alsace became count of Picardy, and about 1350 the House of Valois established the first military government of the province. In 1435 Picardy was annexed by Burgundy, and in 1477 the province was united to France. The region is now included in the Departments of the Somme, Pas de Calais, Aisne and Oise. During the early and closing stages of the World War, Picardy was the scene of bitter fighting.

PICARESQUE ROMANCE, a type of autobiographical fiction which amusingly depicts the adventures of a roguish servant (Spanish *picaio*). A Spanish invention, its earliest generally acknowledged example is the *Lazarillo de Tormes* (anonymous, 1554), an extremely popular work which was widely imitated, notably in Mateo Aleman's *Guzman de Alfarache*, and which founded a new school of fiction. In the 17th century, noteworthy Spanish picaresque romances were written by F. L. de Ubeda, Pedro de Cevallos, F. L. de Larmarca, V. M. Espinel and many others. The greatest picaresque romance in French is Le Sage's *GIL BLAS*. In English, the first picaresque romance was Thomas Nash's *Life of Jack Wilton*, 1594, later examples are *Meriton Latioon*, 1665, by R. Head and F. Kirkman, Fielding's *Jonathan Wilde*, 1743, and Smollett's *RODERICK RANDOM*.

BIBLIOGRAPHY.—F. W. Chandler, *The Literature of Roguery*, 1907, J. Fitzmaurice Kelly, *A New History of Spanish Literature*, 1926.

PICASSO, PABLO RUIZ (1881-), Spanish painter, was born at Malaga in 1881. In 1900 he went to Paris and for several years passed through phases which have since been known as his "blue" and "rose" periods. In 1907 he and Georges Braque were greatly influenced by PAUL CÉZANNE and primitive Negro sculpture. In the following year Picasso and Braque initiated the elementary phases of CUBISM, a distinctly new approach to painting. From this time onward, the artist experimented in many different forms of Cubism. He has been one of the most versatile modern painters, and practically stands by himself in his continual experiments with form and color. Among his important paintings are *The Sweet Tooth*, Josef Stransky Collection, New York; *La Toilette*, 1905, Albright Art Gallery, Buffalo; *Green Still Life*, 1914, Bliss Collection, Museum of Modern Art, New York; *Pierrot*, 1918, Adolph Lewisohn Collection, New York; *Still Life*, 1918, Phillips Memorial Gallery, Washington; *Woman in White*, about 1923, Bliss Collection, Museum of Modern Art; *Seated Woman*, 1927, Mary Hoyt Wiborg Collection, New York; and illustrations for Ovid's *Metamorphoses*. See Maud Dale's *Picasso*, 1930.

PICAYUNE, the Spanish half-real in Florida and Louisiana. Since the half-real is equivalent to 6¼ cents, picayune is sometimes applied to the nickel.

PICCADILLY, an important street in London, England, containing many handsome shops and residences, and extending from Piccadilly Circus, a busy,

triangular open space at the eastern end, to Hyde Park Corner. Its name has reference to the "piccadilles" or "pickadils," an ornament of dress fashionable in the 16th-17th centuries.

PICCARD, AUGUSTE (1884-), Swiss scientist, was born at Basle, Jan. 28, 1884. He graduated from the Swiss Polytechnic School at Zurich. Since 1922 he has been a professor at the Brussels University Polytechnic Institute. Wishing to study the cosmic rays, Piccard and an assistant ascended to a height never before reached by man, 52,462 ft., in a specially constructed balloon, landing on the Gurgl Glacier, Austrian Tyrol, on May 27, 1931. On Aug. 18, 1932, he undertook a second flight and broke his previous altitude record by over 2,300 ft., besides furthering his investigations into the stratosphere and the cosmic rays.

PICCOLO, a musical instrument. See FLUTE.

PICCOLOMINI, OCTAVIO (1599-1656), Austrian general, was born at Florence, Italy, Nov. 11, 1599, the grandnephew of Pope Pius II. In 1605 he served in the Spanish military forces as a pikeman, and in 1627 entered the Imperial Army as a colonel in WALLENSTEIN's bodyguard. Piccolomini distinguished himself in the Battle of LÜTZEN, 1632, and was made a field-marshal by the Emperor. The following year he joined Wallenstein in the invasion of Silesia. Although Wallenstein had been his benefactor, Piccolomini participated in the former's assassination, Feb. 29, 1634, and received a magnificent reward. He defeated the French decisively at Thionville in 1639, and in 1648 was promoted to the rank of lieutenant-general. As such he waged the concluding battles of the THIRTY YEARS' WAR and in recognition of his services was created prince. He died at Vienna, Aug. 10, 1656.

PICHER, a city of Ottawa Co. in northeastern Oklahoma near the Kansas border line. It is served by the Miami Mineral Belt and electric railways, and is a center of the mining district which yields a large per cent of the lead and zinc mined in the United States. Picher is built on land owned by the Quapaw Indians and leased from them. The manufactures include machines and foundries, smelting and welding works. Picher was incorporated in 1920. Pop. 1920, 9,676; 1930, 7,773.

PICKENS, FRANCIS WILKINSON (1805-69), American statesman, was born in Togadoo, S.C., on Apr. 7, 1805, and began practicing law in 1829. In 1834-44 he served in Congress where he vigorously advocated State rights and championed the pro-slavery faction. After being elected governor of South Carolina in 1860, he supported the secession movement, and began to organize an independent government. He ordered all federal property to be surrendered, and to obtain Ft. Sumter erected the batteries which later destroyed it. He died in Edgefield, S.C., on Jan. 25, 1869.

PICKEREL, the name given to certain small fishes of the PIKE family (*Esocidae*), abundant in quiet waters in the eastern United States. There are three species. The most important is the common or chain

pickerel (*Esox reticulatus*), a good food fish, dusky green in color with netted darker lines, very numerous in ponds in the eastern and southern states. Though usually much smaller, it sometimes attains a length of 2½ ft. and a weight of 3 lbs. or more. The little pickerel or grass pike (*E. vermiculatus*), green with dark streaks, found mostly in the Mississippi Valley, and the banded pickerel (*E. americanus*), green with black bars, found near the Atlantic coast, are smaller species, rarely reaching one foot in length. See ANGLING.

PICKEREL WEED (*Pontederia cordata*), a handsome aquatic perennial of the pickerel weed family. It is found in the borders of ponds and slow streams from Nova Scotia to Minnesota and southward to Florida and Texas. The stoutish stem, rising 1 or 2 ft. above the water, bears large bright green leaves,



COURTESY AMER. MUS. OF NAT. HISTORY

PICKEREL WEED

Leaves and flower cluster (upper center) interspersed with flowering stems of the common rush

deeply heart-shaped at the base, and numerous quickly fading blue flowers in terminal spike-like clusters.

PICKERING, EDWARD CHARLES (1846-1919), American astronomer, was born at Boston, July 19, 1846. After graduating from Harvard, he became professor of physics at the Massachusetts Institute of Technology and here established the first physical laboratory in America for instruction purposes. In 1876 he became professor of astronomy at Harvard and director of the observatory. His first great undertaking was the photometric survey of the entire sky, and the determination of the accurate brightnesses of nearly 50,000 stars, in the course of which he established a branch observatory in the southern hemisphere, at Arequipa, Peru. In addition, he became the pioneer in the field of celestial pho-

tography with small telescopes and laid the foundation for the unique library of astronomical photographs at Harvard now containing over 400,000 plates. He died in Cambridge, Feb. 3, 1919.

PICKERING, TIMOTHY (1745-1829), American statesman, was born in Salem, Mass., July 17, 1745. He attended the grammar school and was graduated from Harvard College in 1763. He studied law, was admitted to the bar, and began practice in Salem. He entered the militia in 1766 and after holding several ranks he was elected a colonel in 1775. He held a number of local political offices such as selectman and assessor, 1772-77, town clerk, 1774-76, and was active in the Massachusetts agitation against the policy of the English government, serving as a member of the committee of correspondence and safety in 1774 and 1775. He was also appointed a judge of the court of common pleas for Essex Co. in 1775.

Feb. 1777 Colonel Pickering joined his regiment to the forces of Washington at Morristown, N.J. He was appointed adjutant-general May 24, 1777 and later, Aug 5, 1780, succeeded General Greene as the quartermaster general of the army. The Continental Congress elected him a member of the board of war, Nov. 7, 1777. After the war, Pickering settled in Philadelphia, (1785) for a short period before moving to the frontier region of Wyoming Co., Pa., 1787. In 1789 he was a member of the state constitutional convention and in 1790 he negotiated for President Washington a treaty with the Indians of his district. Washington appointed him postmaster general, Aug. 12, 1791, in which office he continued until his appointment as Secretary of War, Jan. 2, 1795. This position at that time included direction of the navy as well as the army, and also of the Indian department. Washington appointed him Secretary of State Dec. 10, 1795 and he was reappointed by John Adams, Mar. 1797.

Pickering was not qualified for the duties of the office during the stormy international controversies in which the United States found itself and his consistent guidance by Hamilton's opinions, which were disapproved by President Adams, finally resulted in his dismissal from office, May 10, 1800. Heavily in debt, he retired to private life in Pennsylvania before renewing his residence in his native Massachusetts in 1802. The same year he was an unsuccessful Federalist candidate to Congress, but was appointed chief justice of court of common pleas and general sessions of the peace. He served in the U.S. Senate 1803-11 and was one of the spokesmen for extreme Federalist doctrines. He was defeated for reelection in 1811 but in 1812 he was elected as a Federalist to the House of Representatives, serving from Mar. 4, 1813 to Mar. 3, 1817. Pickering relentlessly advocated Federalist policies and in his denunciations of the national government encouraged the New England secession movement. Pickering approved of the Hartford Convention although he did not attend it. He was not a candidate for renomination in 1816, and in 1820 upon his return to Salem as his residence he was defeated as

the Federalist candidate for Congress. He died in Salem, Mass., Jan. 29, 1829.

BIBLIOGRAPHY—O. Pickering and C. W. Upham, *Life of Timothy Pickering*, 4 vols., 1867-73

PICKETING, guarding access to a work place in which a STRIKE is going on. Pickets or patrols, who are strikers or their sympathizers, are stationed about the work place and endeavor to persuade others to discontinue or refuse to accept work therein. Large numbers may gather for what is known as mass picketing to impress employers and strike breakers with their strength and their scorn of SCABS. The main purpose of peaceful picketing is to inform those who have not gone on strike, those hired to take their places or strike breakers and patrons of the plant of the facts concerning the strike and to persuade them to aid by refusing to work or by withholding patronage. Peaceful persuasion is sometimes followed by intimidation, and violence to persons and property may result. On this ground employers frequently resort to injunctions (*see* INJUNCTIONS IN LABOR DISPUTES) to restrain strikers from picketing and the courts have taken a hand.

In the United States some states have statutory provisions against it. Other states allow peaceful picketing and each case rests on its merits. Picketing becomes unlawful only when coercion is resorted to, but the point at which persuasion ends and intimidation begins is difficult to establish and many courts hold that there can be no such thing as peaceful picketing. The device of picketing is important to trade unions (*see* LABOR ORGANIZATIONS) conduct of strikes and the whole question of its legality is a matter of controversy.

P. F. B.

BIBLIOGRAPHY—G. S. Watkins, *Labor Problems*, 1929.

PICKETT, GEORGE EDWARD (1825-75), American soldier, was born in Richmond, Va., Jan. 25, 1825, and graduated from West Point in 1846. In the Mexican War (*see* MEXICO, HISTORY) he was prominent in the actions at Vera Cruz and Chapultepec, and during the northwest boundary dispute with Great Britain he served in the Washington territory and prevented British troops from landing on San Juan Island. (*See* NORTHWEST TERRITORIES PURCHASE.) In 1861 he joined the Confederate forces and the next year served in General Joseph E. Johnston's army where he won distinction as a troop leader. He was commissioned a major-general in Oct. 1862, and at the Battle of Fredericksburg (*see* FREDERICKSBURG, VA., BATTLE OF) commanded the center of the line under General Lee. At Gettysburg, on the third day of fighting, he led the charge on Cemetery Ridge which has become historically famous as the most brilliant feat of arms performed by any Confederate officer. Pickett's division carried the hill and entered the enemy's lines but did not have adequate support and was forced back and almost annihilated. For the remainder of the war he commanded the army in lower Virginia and eastern North Carolina. Pickett died in Norfolk, July 30, 1875.

PICKFORD, MARY (1893-), American motion-picture actress, was born at Toronto, Canada, Apr. 8, 1893. Her first stage appearance was in the Valentine Stock Company, Toronto, as Cissy Denver in *The Silver King*. She starred, at nine, as the child in *The Fatal Wedding*, and also as Mignon in *Bootle's Baby*. After playing Eva in *Uncle Tom's Cabin*, and Willie Carlyle in *East Lynne*, she toured with Chauncey Olcott in *Edmund Burke*, 1906. She was Betty in *The Warrens of Virginia*, at the Belasco Theatre, New York City, 1907, and was starred by DAVID BELASCO in *A Good Little Devil*, 1913. Subsequently she joined the Biograph Motion Picture Company under DAVID W. GRIFFITH, and began her characteristic series of ingenue rôles. Her screen plays include *Tess*, *Stella Maris*, *In the Bishop's Carriage*, *Such a Little Queen*, *Daddy Long-Legs*, *Pollyanna*, *Suds*, *Little Lord Fauntleroy*, *The Taming of the Shrew*, 1930 (with her second husband, DOUGLAS FAIRBANKS), and *Coquette*, 1931.

PICKLE WORM, a moth of the family *Pyrallididae*. The wings of the adult are yellowish brown with a purplish metallic reflection. At the tip of the abdomen is a tuft of black hairs. This insect is injurious principally in the southern states, attacking melons, cucumbers, squashes and pumpkins. Moths appear in the late spring, laying eggs on the flowers, buds and young growth. Larvæ from eggs laid on blossoms usually feed on these. Others bore into leaves, stems and vines when young, feeding exclusively upon fruit when larger. The mature larva is a greenish caterpillar about an inch in length. Two or even three generations occur annually. The pupæ of the last generation pass the winter in trash on or near the surface of the ground. Destruction of waste after harvest is a useful means of control. Early squashes planted among cucumbers and melons attract the females, which lay their eggs on the squashes. These plants may later be destroyed.

PICKLING. Vegetable and animal substances which man desires to use as food must be preserved in some manner to prevent their decomposition by micro-organisms. Chief among the methods which have been used in the past is so-called pickling or immersing in a curing solution. These curing solutions for meats have been used for hundreds of years and usually consist of salt, sugar and saltpeter. The salt acts as a preserving agent, the sugar improves the flavor, while the saltpeter imparts a red color to the meat and also acts to some extent as a preservative. Some cured meats may also be smoked to improve the flavor and aid in their preservation. Vegetables may also be preserved in somewhat the same manner as meats. Cabbage, for instance, is made into SAUERKRAUT by means of salt. Such curing solutions permit desirable bacteria to grow which bring about desired changes. Bacteria which are not wanted are either killed or prevented from growing. Foods which are preserved in this manner usually have a distinct but pleasing flavor. They help to relieve the monotony of a diet in which fresh meat usually

abounds. Furthermore, they permit the saving of food which is abundant in one season for another season when it is not. See also PICKLES. F. W. T.

PICKLING OF METALS. In the working of metals, oxide or scale is usually developed upon the metal surface especially after heat treatment. Further processing or use generally requires a clean metal surface. This may be restored by "pickling" or the chemical removal or loosening of such scale and in some cases extraneous matter or dirt.

Sulphuric acid is one of the cheapest chemical reagents and is widely used for pickling. The commercial concentrated acid—60 or 66° Baumé—is diluted with water to a strength between about 2 and 10% depending upon the application. The pickling



MR. PICKWICK IN THE POUND
A drawing by Phiz (H. K. Browne) for Dickens' "Pickwick Papers"

bath is usually heated to temperatures between about 125° and 180° F. Under these conditions steel may be cleaned in a few minutes.

Steel pickling has received much study and for many years pickling inhibitors have been used to increase pickling efficiency. Inhibitors reduce the acid attack upon the metal 90% or more with consequent large metal and acid savings. Hydrogen absorption and the embrittlement of steel during pickling are largely prevented by inhibitors. These materials or compounds generally contain nitrogen. High protein flours and nitrogen bases from tars and sludges are used. In recent years stronger inhibitors containing thiourea compounds have been developed.

Alloy or stainless steel and non-ferrous metals may require acids other than sulphuric for satisfactory

cleaning. Muriatic acid is often used. Nitric acid may be applied where the metal resists oxidizing attack and is especially valuable for stainless steels. Mixed acids and sometimes salt additions are used. J. C. W.

PICKWICK PAPERS, a long and humorous narrative by CHARLES DICKENS; published 1837. The elderly Mr. Pickwick, a good and simple gentleman, founds a club, the chief members of which are his friends the Messrs. Tupman, Winkle and Snodgrass, all men of marked eccentricities. When the club goes traveling by stage over England, the members continually involve themselves in droll adventures. They meet the extraordinary impostor, Alfred Jingle, are taken into high society by Mrs. Leo Hunter, spend a delightfully rustic Christmas holiday at "Dingley Dell," and reach the culmination of their adventures in Mrs. Bardell's absurd but determined suit against Pickwick for breach of promise. One of the most important characters is Sam Weller, Pickwick's faithful servant, as homely in his philosophizing as SANCHO PANZA.

PICO DELLA MIRANDOLA, GIOVANNI, COUNT (1463-94), Italian theologian and philosopher, was born at Mirandola Feb. 24, 1463. He was educated at the University of Bologna and elsewhere in Italy and France. Upon his return to Rome in 1486, according to the custom of the time, he posted 900 theses challenging scholars to debate with him questions of philosophy, science and mathematics. He was much interested in Cabalism and in Neo-Platonism. Among his works are *Heptaplus*, an allegorical theory as to the creation of the world and *De Ente et Uno*, an attempted synthesis of Plato and Aristotle. Pico gave away all his wealth to become a wandering preacher, but died shortly after in 1494 when only 31 years of age. Savanarola preached his funeral sermon. Pico appears in Alfieri's drama, *Savanarola*.

PICO ISLANDS. See AZORES.

PICRIC ACID, a yellow crystalline acid used in explosives, known also as symmetrical trinitrophenol, $C_6H_2(NO_2)_3OH$. It was first prepared by treating indigo with nitric acid (Woulfe, 1771). It is manufactured by dissolving phenol (C_6H_5OH) in concentrated sulphuric acid and treating the phenolsulphonic acid thus obtained with very strong nitric acid. Picric acid crystallizes in lustrous yellow leaflets which melt at 122.5° C. Dilute solutions of it are sometimes used as antiseptics, particularly for wounds caused by burns. Formerly picric acid was employed as a dye, but its color is not fast to either light or washing. Its principal use is in EXPLOSIVES. Shells are filled with the melted acid, which is exploded by the use of a primer and detonator. L. C. A.

PICTOGRAPHS, forms of picture-writing. The most interesting primitive examples have been furnished by the American Indians, whose records, now mostly undecipherable, on rocks (see PETROGLYPHS), birch-bark, skins, etc. are scattered plentifully throughout North America. It is a natural supposition that all writing began with pictographic ideograms, gradually developing into symbolic and then phonetic

signs. But the earliest known Egyptian hieroglyphics, about 5000 B.C., antedating the first historic king, show a fully developed system of combined pictographs, symbols, phonetic syllabaries and alphabetic letters. Other forms of writing, such as the Chinese and the Babylonian cuneiform, apparently ideographic and



COURTESY AMER MUS OF NATL HISTORY

PICTOGRAPH ON A WALL OF THE CANYON DEL MUERTO, ARIZONA

pictorial at first, had developed similarly before history began.

Some traces of pictographic ideograms survive in our own language. The arrow or the hand pointing, \rightarrow , \rightarrow , the mathematical symbols I, II, III, $=$, $>$ and $<$ are examples. See also CUNEIFORM; HIEROGLYPHS; IDEOGRAMS.

PICTOR (gen. *Pictoris*), the painter's easel, an insignificant constellation adjacent to Canopus. See STAR: map.

PICTS, a prehistoric people who once inhabited Great Britain. Apparently of Iberian origin, they were probably akin to the Latin *pictones* and the *pictari* of Gaul. Their name for themselves, *Cruithne*,—in Irish *Cruithne*, in Welsh *Prydyn*,—is similar to the Greek name for the British Islands, *Prettonic* Islands. Later, inhabiting the Highlands, the Picts came into conflict with the Romans and the Strathclyde Britons. In 689 they defeated the Saxons. Kenneth MacAlpine, King of the Scots, conquered them in 846. The gradual fusion of Picts and Scots began in the ninth century.

PICTURE OF DORIAN GRAY, THE. See DORIAN GRAY, THE PICTURE OF.

PICUL, a unit of weight used in the Orient, especially in China, equal to 100 CARRIES and equivalent to from 133 to 140 lbs. avoirdupois.

PICURIS, an American Indian pueblo and tribe speaking the Tigua dialect of the Tanoan linguistic stock. The pueblo is situated about 40 mi. north of Santa Fe in New Mexico. The Picuris took an important part in the Pueblo Rebellion of 1680 when the pueblo was abandoned to be rebuilt near by a few years later. They again abandoned the pueblo in 1704, taking refuge in a Jicarilla Apache settlement. In consequence, the Picuris are said to have been considerably interbred with Apache.

PIDDOCK, the popular name for members of a genus (*Pholas*) of bivalve mollusks (*Lamellisbranchia*) common on the Atlantic coasts of North America and Europe. It has an elongate shell, from 2 to 3 in. long, which has tooth-like projections on its surface.

The piddock is remarkable for its ability to bore into such substances as clay, peat, chalk or even very hard rock. In boring the animal attaches itself by its foot and uses its shell as a file. It lives deep in its hole, with only its siphons, which are from 4 to 9 in. long, reaching the opening.

Several species of piddock are found on American shores, the most familiar of which, *Pholas truncata*, digs in clay or peat between the tide marks. Some kinds are good to eat, and one, *Pholas dactylus*, which has riddled England's chalk cliffs with its holes, is known to be luminescent. See also PHOSPHORESCENCE.

PIDGIN-ENGLISH ("Business" English), a jargon used as a medium of oral communication between English-speaking foreigners and Chinese in the port cities and in the interior of China. It is a conglomeration of corrupted English, mostly monosyllabic, Portuguese and Chinese words, adapted to the native rules of phonetics and syntax. Its chief characteristics are overhanging vowels and the change of *r* to *l*; e.g., "much" becomes "muchee"; and "American," "Melican."

BIBLIOGRAPHY—K. Letzer, *Dictionary of the Slang-English of Australia and of Some Mixed Languages*, 1892, C. G. Leland, *Pidgin-English*, 5th ed., 1900.

PIECES-OF-EIGHT, a name formerly applied to Spanish silver dollars or Pesos. These dollars were divided into eight reals, which suggested the name of pieces-of-eight.

PIECEWORK, a system of wage payment which relates wages to output rather than to a period of time like an hour, a day or a week. It may be classified under the general head of payment by results. Simple piecework, in the sense in which it is ordinarily used, involves merely setting a rate for each performance of a given operation, and calculating the wage payment by multiplying the rate by the number of times the operation is performed within the wage-payment period. More complex methods of payment by results are usually given other names, such as the task and bonus system. The chief arguments advanced in favor of piecework are that it increases output and furthers justice among workers by rewarding the more efficient according to their deserts. Numerous objections are sometimes advanced against it from the point of view of labor, such as that it produces inhuman speeding up, that it victimizes the less efficient, that as soon as wages are raised by higher production, the rate will be lowered, so that the worker will receive the same amount as before for a greater effort. From the point of view of the employer, piecework may be undesirable because it leads to fatigue and uneconomic labor turnover, or because it places a premium on quantity at the expense of quality, or because by arousing the opposition of the worker it leads to deliberate slowing up. Piecework is better adapted to some processes than to others; it can be used only with difficulty where the operations are varied and not capable of STANDARDIZATION. Its advantages have been found to outweigh its disadvantages in numerous instances, such as cases in which

labor is protected by a process of setting rates resting on collective bargaining. G. S.

PIEDMONT, a territorial division of northern Italy, is composed of six provinces: Turin, Cuneo, Alexandria, Novara, Vercelli and Aosta. It was inhabited in early ancient times by people of Celtic origin. It was conquered by the Romans and formed part of Cisalpine Gaul. Later it was invaded by the barbarians and passed from conqueror to conqueror until in the 11th century it fell to the House of Savoy by the marriage of Otto IV and Adelaide of Susa. The Duchy of Savoy, of which Piedmont was the largest part, became a kingdom according to the terms of the TREATY OF UTRECHT, 1713, and was generally known as the Kingdom of Sardinia after 1720 because of its island possession. Piedmont played a leading rôle in the Italian *risorgimento* of the 19th century, providing such leaders as CHARLES ALBERT, VICTOR EMANUEL II, and COUNT CAMILLO CAVOUR, supplying the most important of the military forces for action against Austria, and contributing a constitution and a ruler to the nascent state of Italy.

PIEDMONT, a residential city entirely surrounded by Oakland, situated in Alameda Co. in western California, near San Francisco Bay. There are no industries and few shops. The residents of the community control the building and zoning restrictions for hotels, apartment houses and shops. The city has a council government of five members who are elected to office for a period of four years, serving without pay. Pop. 1920, 4,282; 1930, 9,333.

PIEDMONT REGION, the name designating the low plateau which lies between the Atlantic coastal plain and the Appalachian Mountains. It extends from Pennsylvania to Georgia and reaches its maximum width of about 300 mi. in North Carolina. The region is rolling and frequently quite rugged with deeply eroded valleys due to its peneplain formation. Many streams and rivers cross this plateau from east to west and descend to the coastal plain. This definite line of escarpments is known as the fall line. Its falls, cascades, and rapids are the source of valuable water power and along it the important manufacturing cities of the several states have grown up. The Piedmont region is a rich agricultural district and includes an exceptionally fertile cotton area in South Carolina. Fruits also form an important crop.

PIED PIPER OF HAMELIN, THE, a children's poem by ROBERT BROWNING; published 1842. Based on an old German legend, it is the story of a mysterious gypsy piper who arrives in Hamelin and agrees to rid the town of the rats which are destroying it. This he does, playing upon his pipe till the rats come out of their holes and are drowned in the river. But the citizens refuse to pay the piper. So once more he sounds his pipe, but this time it is to charm the children of Hamelin, all of whom follow him to a cave in the mountains where they disappear forever.

PIEGAN, one of the three groups comprising the BLACKFOOT or Siksika. The greater number of the Piegan live in Glacier Co., Mont., while the remainder

are under the jurisdiction of the Piegan Agency in Alberta, Canada.

PIER, a term applied to a detached masonry member serving as supports for a structure such as a bridge. This term is also applied to any compression member, in which the ratio of the unsupported length to the least width, is four or less. Also, wharves projecting into a body of water. The water areas between piers are called "slips." The wall at inner ends of slips is called the "bulkhead."

PIER, in architecture, a vertical support, usually of masonry, differentiated from **COLUMN** by the fact that piers are generally square, rectangular or complex in plan, whereas masonry columns are circular, and also by the fact that the word pier usually connotes a sturdier support, wider in proportion to its height. The pier has provided a constant opportunity for decorative development from early times. The Osirid piers of some Egyptian architecture, as in the Temple at Luxor, 18th Dynasty, are examples of one type of decoration in which sculpture is boldly applied to the support. A more usual decorative treatment invented by the Romans was that based on making the pier plan expressive of the arrangement of the superstructure. Thus where four arches at right angles are supported, as in the Basilica Julia in Rome, the piers are cross shaped, and so on. Another Roman invention was the T-shaped pier, in which a rectangular pier supporting two arches in line was decorated by applying a pilaster to its outer side; the plaster carried an entablature running continuously above the arches. The Romanesque architects developed these Roman prototypes still further, especially in Lombardy and France, producing types of great interest, with some elements square and some rounded like engaged columns. From these Romanesque beginnings grew the great richness of the Gothic clustered piers. See **ROMANESQUE ARCHITECTURE**; **GOthic ARCHITECTURE**.

PIERCE, FRANKLIN (1804-69), 14th President of the United States, was born at Hillsborough, N.H., on Nov. 23, 1804. He was the son of Gen. Benjamin Pierce, who served in the Revolutionary War and was twice governor of New Hampshire, and Anna Kindred Pierce. His parents were of English descent, and the son was educated in private schools where the religious training was Episcopalian. He attended Franchestown, Hancock, and Phillips Exeter, and entered Bowdoin College, Me., in 1820, where he became a close friend of Longfellow and Hawthorne. He was graduated in 1824, and, in accordance with the family tradition of public service and political activity, decided to study law. The next three years were devoted to studies in the office of Sen. Levi Woodbury at Portsmouth, N.H. and at Northampton, Mass. Pierce was admitted to the bar in 1827, and opened his office at Hillsborough.

The young lawyer soon became identified with the Democratic party in state affairs. In 1829 he was elected to the lower house of the state legislature, in which he was speaker during 1831-32. The next year Pierce ran successfully for the national House

of Representatives, where he became an ardent supporter of Jackson, upholding the administration on all important questions. Pierce seldom spoke from the floor, but he was, nevertheless, a power, especially in committee work. He showed himself a strict constitutionalist, and opposed the second charter for the United States Bank. In this period he also opposed appropriations for the United States Military Academy, and was the chief advocate in Congress of a volunteer army. In 1837 Pierce was elected to the Senate, and at 33 was the youngest member in the upper house. In consequence he had little opportunity to distinguish himself amid a mature company that included Clay, Webster and Benton. He resigned in 1842, before the end of his term, returned to New Hampshire to resume law practice, and in 1845 and 1846 declined important public posts, including that of attorney-general in Polk's cabinet. The Mexican War, however, again brought him before the public. He enlisted as a private, and was promoted to the colonelcy of the ninth regiment. Pierce accompanied Winfield Scott on the march to Mexico City, and on the eve of the battle of Contreras he was commissioned a brigadier-general. In the battle Pierce was severely injured by the falling of his mount, but refused to leave the field. He returned to New Hampshire to preside over the State Constitutional Convention of 1850. At the Baltimore Democratic Convention two years later, Pierce was pushed forward as a "dark horse" candidate, and the delegates, unable to agree on Cass, Buchanan or Douglas, nominated him on the 49th ballot by 282 votes to 6 for the remaining candidates. His emphatic support of the **COMPROMISE OF 1850**, and his insistence that slavery was settled made him acceptable to the South. He received 254 electoral votes, as against 42 for Gen. Winfield Scott, Whig, and took office in Mar. 1853.

Pierce chose William L. Marcy as Secretary of State, Jefferson Davis as Secretary of War, and James Guthrie as Secretary of the Treasury. From the outset he strove to ignore the slavery controversy. He asserted that his foreign policy would "not be controlled by any timid forebodings of evil from expansion." Thus the question of the annexation or purchase of Cuba was increasingly discussed by officials, warmed by the President's words. The project did not progress beyond the famous **OSTEND MANIFESTO**. Anxious to increase foreign trade, Pierce sent Com. Perry to Japan to persuade the country to open its ports to American trade. He gave support to the Gadsden negotiations (see **GADSDEN PURCHASE**) for the purchase from Mexico of a border strip needed for a transcontinental railroad linking California with the rest of the country. Pierce was also active in plans for settlement of the Northwest. His signature of the **KANSAS-NEBRASKA BILL** which repealed the Missouri Compromise, led to bitter controversy between opposing factions on the slave issue, and his later pro-slavery attitude lost him political support, as well as the Democratic renomination, in the North.

Pierce retired after his term to his home at Concord,

N.H., and in a few months left the United States, remaining for three years in Europe. He died at Concord, N.H., on Oct. 8, 1869, following an attack of dropsy and inflammation of the stomach, and was buried in Minot cemetery.

In 1834 Pierce married Jane Means Appleton, daughter of the president of Bowdoin College, and the mother of his three sons.

BIBLIOGRAPHY—Nathaniel Hawthorne, *Franklin Pierce*, 1852; R P Nichols, *The Democratic Machine, 1850-54*, 1923; R P Nichols, *Franklin Pierce*, 1932; J R Irelan, *History of the Life, Administration and Times of Franklin Pierce*, 1888.

PIERRE, the capital of South Dakota, a city in the central part of the state, the county seat of Hughes Co. It is situated on the Missouri River, 325 mi. northwest of Sioux City, Iowa and is served by bus lines, river craft, the Chicago and North Western Railroad, and an airport. Noteworthy among its buildings are the capitol, housing the administrative offices and the State Historical Museum, and a World War Veterans memorial building. A beautiful park extends along the river front for a mile. Across the river is the buffalo pasture. Job printing, bookmaking and stone and marble works are the chief industrial interests. The region produces oats, barley, wheat and other grains. This territory was claimed for France by La Vérendrye in 1743. The plate which he buried near here, engraved with this claim, was discovered in 1913. Fort Pierre Chouteau was established in 1832. Pierre was laid out in 1880 and organized in 1883. Pop. 1920, 3,209; 1930, 3,659.

PIERS PLOWMAN, THE VISION OF, an English allegorical poem of the 14th century, commonly ascribed to WILLIAM LANGLAND. The poem tells of a vision or dream which Piers the Plowman has one day when, falling asleep on a hill, he sees a field full of people of all classes and conditions of life. The heartlessness of the rich is shown, as are the oppression of the poor and the corruptions of the clergy; and there are numerous allegorical figures, such as the Seven Sins, Conscience, Patience and others. The poem is valuable chiefly because it shows the social conditions of the time.

PIETTE, MGR. A. V. JOSEPH (1869-), Canadian educator, was born at Berthier, P.Q., 1869. He was graduated from Laval University, Montreal, and was ordained a priest in the Roman Catholic Church in 1892. After serving as curate and as parish priest, he became vicar general of the archdiocese of Montreal in 1922, and later apostolic prothonotary. In 1923 he was appointed rector of the University of Montreal.

PIEZO-ELECTRICITY, an electric charge on a crystal produced by pressure. Certain crystals, notably those of quartz, tourmaline and Rochelle salt, become charged on certain parts when subjected to mechanical pressure, the charge being proportional in magnitude to the pressure applied. When so charged, there is a potential difference between the charged parts and other portions of the crystal. A crystal of Rochelle salt compressed between metal plates may show a potential difference of 100 volts or more between

the plates and a metallic band placed around the middle of the crystal.

The effect is reversible. When a crystal of quartz is charged, its physical dimensions are changed, and, if subjected to a varying electromotive force, it will vibrate mechanically and generate, because of the vibrations, periodic surface voltages. Any such crystal has a natural period of vibration which is determined by its dimensions. Temperature changes affect the period of a crystal, but, at constant temperature, its period is definite and very constant. This property of the crystal is utilized in the control of radio carrier-wave frequencies (*see* RADIO COMMUNICATION) by means of a quartz plate. A quartz crystal of proper thickness is placed between metal plates, forming a sort of CONDENSER. The mechanical vibrations of this crystal produce a varying electromotive force between the plates which, impressed by means of suitable connections upon the station OSCILLATOR, holds the station FREQUENCY to that of the vibrating crystal. L. B. S.

PIGAFETTA, FRANCESCO ANTONIO (1491-1535), Italian navigator and explorer, who accompanied Magellan in his circumnavigation of the globe, 1519-1522, and was one of the 18 men who completed this voyage. The only account of this trip now extant is Pigafetta's diary. Emperor Charles V ordered Pietro Martire d'Anghiera to write a history of the voyage and to help in the work. Pigafetta gave him a copy of the diary, but the account written by Martire was lost in 1527 when Rome was sacked. The first complete account of the voyage was published in 1800 under the title *Primo Viaggio intorno al Globbo Terracqueo*.

PIGEON, a bird of the family *Columbidae*. The characteristics of the family are well shown in the peculiar beak, cere, feet and general form of the domestic pigeon, a descendant of the wild rock-dove of Europe. More than 300 species of the family are recorded, mainly in the East Indies, Polynesia and Africa. They are, as a rule, forest birds, requiring mixed vegetation and proximity to water. Certain species gather into vast, migratory flocks, but most of the race are inclined to be solitary and resident, although their power of flight is strong. Woods-dwelling pigeons live on seeds, acorns and berries; the ground-running kinds eat grass and the seeds and tender sprouts of plants; and the many different fruit-pigeons of the East subsist on forest and cultivated fruits. These fruit-eaters include some of the largest and most richly adorned members of the family. The largest of the pigeons are the aberrant crowned pigeons of the Papuan and Solomon islands, whose enormous crests, called goura plumes, were formerly so greatly sought after that the birds were nearly exterminated. The nests of most kinds are flimsy affairs on branches of trees, and hold two white eggs. *See* DODO; DOVE. E. I.

PIGEON-HOLING, a term applied to the smothering of a bill in the committee to which it has been assigned for consideration. A bill that is pigeon-

holed is not reported back favorably or unfavorably to the legislative assembly. Many bills introduced in each session of Congress are thus disregarded.

BIBLIOGRAPHY—C. A. Beard, *American Government and Politics*.

PIGEON POST, a system of communication in which trained homing or CARRIER PIGEONS are employed to carry messages attached to their bodies. Messages may be carried as far as 500 or 600 mi. by well trained pigeons, at an average flying speed of 30 to 45 mi. per hour. This system of communication was used by the ancient Persians and Greeks and was of particular value until the development of the TELEGRAPH. It is still employed in war time for conveying messages from the front.

PIGFISH, a small marine fish (*Orthopristus chrysopterus*) of the Atlantic coast from New York to Mexico and excellent as a pan fish, so called from the grunting noise which it makes when taken from the water. See GRUNT.

PIG IRON is produced by the smelting of iron ore in a blast furnace. Its chemical composition varies as shown in the following range of percentages: iron, 92 to 95%; carbon, 3 to 5%; manganese, 0.50 to 2%; phosphorus, 0.05 to 1%; sulphur, 0.02 to 0.10%; silicon, 0.50 to 3%. It sometimes contains other elements in small amounts as copper and nickel. The carbon may be either in the uncombined graphitic state or combined with the iron in the form of a carbide. Pig iron is used in making steel (see OPEN-HEARTH PROCESS and BESSEMER STEEL) and also in making iron castings. See also IRON BLAST FURNACE.

PIGMENTS, finely-divided, insoluble powders yielding paints when mixed with suitable media and driers. They are obtained chiefly from mineral, but also from vegetable and animal sources. The pigment does not dissolve in the medium, but mixes with it, converting it into a muddy, opaque liquid. Its chief physical properties are fineness, brightness and clearness of tone, strength, covering power and permanency. Pigments were used in the decorations of the ancient temples of Luxor and Karnak. Hubert and Jan Van Eyck first used pigments in oil painting in 1400. Between the 12th and 17th centuries there were but nine or ten pigments. Today there are 215 or more, of which WHITE LEAD is the oldest. It is referred to by Pliny as existing as early as 400 B.C. See also COLOR.

PIGWEED, a name given to various plants of the goosefoot family, particularly those widespread as field and wayside weeds, as, for example, the lamb's quarters (*Chenopodium album*), of world-wide distribution, and the winged pigweed (*Cycloloma atriplicifolium*), a tumble-weed of the Great Plains region. The name is given also to various weedy species of amaranth, especially to the green amaranth (*Amaranthus retroflexus*) and the spleen amaranth (*A. hybridus*). Various other plants are locally known as pigweeds.

PIKA, an alpine rodent (*Ochotona princeps*), called also rock-rabbit and little-chief hare. This

small, practically tailless cousin of the rabbits inhabits the summits of the Rocky Mountains and Pacific Coast ranges. It resembles in size and form a buff-colored guinea-pig, and belongs to the grassy zone just above timber-line, where loose rocks offer a colony safe homes. Such colonies are usually isolated and stationary, resulting in many local varieties of this widely distributed species. The pikas appear in summer in alert, chattering groups, fattening on the fresh grass or plants. In August each pair collects quantities of herbage and piles it on the warm rocks to dry in the sunshine; when a sufficient amount has been "cured," it is taken into the home and store-house among the rocks, and maintains the family during their snow-buried winter. E. I.

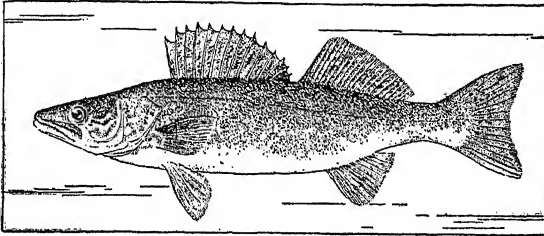
PIKE, ZEBULON MONTGOMERY (1779-1813), American explorer and soldier, born at Lambertton, N.J., Feb. 5, 1779. He entered the army and was made a first lieutenant in 1800. In 1805, he headed an expedition organized by President Jefferson to explore the Mississippi River from St. Louis to its source, an unknown part of the Louisiana Purchase, and upon his return the next year he was sent to explore the country southwest of St. Louis. He went up the Missouri River into Kansas and from there he followed the Arkansas River into Colorado and arrived at Pikes Peak, which was named for him. After completing this mission, he was commissioned a colonel in the army and in the War of 1812, took part in the campaign against York (Toronto), Can., where he was killed, Apr. 27, 1813.

PIKE, the general name for a small family (*Esocidae*) of soft-rayed, fresh-water fishes. Besides the common pike, abundant in northern waters throughout the world, the group includes the muskellunge and various pickerel found in the eastern United States and Canada. All have a slender, long snouted body, with a large mouth and strong sharp teeth, and feed voraciously on fishes and other aquatic animals. Pike are excellent food fish, with white, flaky, well flavored flesh; the larger species rank highly as game fish.

The common pike (*Esox lucius*) occurs in lakes and streams from the northeastern United States to Alaska and also in Europe and Asia. It is olive-gray in color, with whitish or yellowish spots and bars and attains a length of 4 ft. and a weight of 10 to 20 or sometimes 40 lbs. Several fishes of the perch family are called pike, especially the pike-perches (*Stizostedion* sp.). See also MUSKELLUNGE; PICKEREL; PIKE-PERCH; ANGLING.

PIKE-PERCH, a small genus (*Stizostedion*) of fresh-water fishes of the PERCH family (*Percidae*), so called because of the resemblance of the snout to that of the PIKE. They have a long slender body with a large mouth and are exceedingly voracious. Three species of importance as food and game fish occur in the lakes and streams of the eastern United States and Canada. Of these the largest is the wall-eye (*S. vitreum*), called also wall-eyed pike and yellow pike, characterized by a very large glassy eye. It attains a

length of 3 ft. and a weight of 20 to 30 lbs., and is an excellent food and game fish. The similar but much smaller sauger pike (*S. canadense*), called also sand pike, and blue pike (*S. glaucum*), are also extensively used for food. In 1929 the commercial catch of these



PIKE-PERCH OR WALL-EYED PIKE
Stizostedion vitreum

species, practically all taken in the Great Lakes region, in amount and value was as follows: wall-eye or yellow pike, 2,384,000 lbs., \$398,000; sauger pike, 1,641,000 lbs., \$130,000; blue pike, 2,835,000 lbs., \$189,000.

PIKES PEAK, a well-known peak of the Rocky Mountains located in El Paso Co., Colorado, about six mi. west of Colorado Springs. It rises to an elevation of 14,109 ft. above sea level and, although exceeded in height by many other summits in the state, it has the most advantageous location for displaying its altitude and is the best known. Forests of pine and fir extend to nearly 12,000 ft., above which line the slopes are bare granite covered in the winter time with snow which mostly disappears in the summer season. The north side once had large glaciers which scoured out great cirques and converted the slope into nearly vertical walls. Pikes Peak was first seen by Lt. Zebulon M. Pike in 1806 when exploring certain parts of the Louisiana Purchase for President Jefferson. It was first ascended in 1820 by Dr. Edwin James in Maj. S. H. Long's expedition. Since 1891 a cog railroad has carried tourists to its summit and this was later supplemented by an automobile road. The summit is a comparatively level spot of nearly 60 acres.

PILATE, PONTIUS, (early 1st century A.D.), fifth Roman procurator of Judea, Idumea and Samaria, 26-36, A.D. Nothing is known of his birth and death, although it is supposed that he was of equestrian origin. He was appointed through the influence of Sejanus, but his condemnation of Jesus, when he was tried before him, has insured the perpetuation of his name. There are many legends concerning him, some of which say he was converted, enabling the Abyssinian Church to create him a saint. His appearance with Judas in medieval morality plays has given us the *Punch* ("Pontius") and *Judy* of the present day.

PILCHARD, the name commonly given in Great Britain to various small fishes of the herring family, especially to the common pilchard (*Sardin pilchardus*), one of the most important food fishes of the English Channel. It is a deep water fish, migrating in vast shoals, abundant in the Mediterranean and on the

Atlantic coasts of Europe. When full grown it is about 10 in. long, greenish-blue above and silvery white below. It feeds on minute crustaceans and other marine animals and requires two or three years to attain maturity. When about 3 or 4 in. long it is taken in immense numbers and preserved for the markets either by salting or canning in oil. Those preserved in oil are usually called sardines. See also **SARDINE**.

PILE DRIVERS, machines for driving piles into the ground in building and construction work. They may be classified as ram, or monkey, drivers, steam drivers and hydraulic drivers. In the ram type a heavy weight is lifted and allowed to fall, in a series of blows, upon the head of the pile. The ram is raised by a rope which passes over a pulley at the top of a **DERRICK** and it is guided by runners or slides. For small piles the ram may be raised by hand, but for heavier work power is used, either a steam or electrically driven **WINCH** being employed. In the power type, arrangement is provided for tripping the ram at the top of the lift and for connecting the lifting rope to it again after it falls. In one type of driver the ram is lifted by an **ELECTROMAGNET** which merely requires the operation of a switch for tripping and picking up the ram.

In the steam pile drivers, the ram principle is used but the ram is replaced by a heavy cast-iron steam cylinder (see **STEAM ENGINE**), the piston of which rests on the top of the pile. As steam is admitted back of the piston the heavy cylinder is raised, the reaction forcing the pile into the ground.

In the hydraulic type, used only in sand and gravel, a nozzle is placed at the point of the pile and water is pumped through it to soak the sand. This allows the pile to sink by its own weight.

PILE FABRIC, cloth having a surface composed of short threads protruding from the body of the texture and in many cases standing erect. The pile threads may be supplied to the looms either as extra warp or as extra filling. If as warp, they are woven over a series of wires placed, usually automatically, across the fabric. The wires are continually withdrawn from the woven fabric and reinserted near the point of shuttle traverse. A plain wire leaves a row of uncut loops across the fabric, such as are seen on Brussels carpet; whereas a wire with a protruding knife edge on the end cuts the loops as it is withdrawn and forms a surface of single ends, as in Plush and Velvet. Sometimes a plain wire with a groove along the top is used, a knife being later passed along the groove to cut the loops. When the pile threads are supplied as extra filling, they are made to float or skip over several warp threads, leaving relatively long sections of their length exposed on the surface of the fabric. After the fabric is removed from the loom, these sections or floats are cut by a wedge-shaped knife placed under them and manipulated either mechanically or by hand. Other pile fabrics are made by weaving two cloths simultaneously, one above the other, with the pile threads extending from

one to the other; the threads are cut half way between the two fabrics to form a pile surface on each.

E. D. F.

PILES. See HEMORRHOIDS.

PILGRIM FATHERS, a popular term for the earliest settlers in Massachusetts and, more specifically, the group who arrived at Plymouth in the *MAYFLOWER*, 1620. The analogy of their journey across the Atlantic to the travels of pilgrims in the Middle Ages is probably responsible for the designation. The Pilgrim Fathers, unlike the PURITANS, were Separatists from the Church of England, and had formed Independent (Congregational) churches in England and in Holland before they emigrated to the New World.

PILGRIMS, THE, derived their name from that passage in the 11th chapter of the Epistle to the Hebrews, which speaks of "strangers and pilgrims on the earth," who "seek a better country." They used the term in their first migrations from England to the Netherlands, and it was well known when the PILGRIM FATHERS later established their colony in 1620 at New Plymouth, Mass. The pilgrims stood for the sufficiency of the Bible as the rule of their faith, and for a democratic government with religious motives and restraints. These two principles have since widely influenced numerous churches and states.

When the Pilgrims established their first churches at Gainsborough and Scrooby in England, their aim was to constitute a church on New Testament lines, because (1) "the profane and the ungodly were admitted to the communion" of the Anglican Church; (2) the various ecclesiastical offices and ranks had no warrant in the Bible, and (3) the church was "in subjection to an anti-Christian and ungodly government." For eight or nine years they worshiped unmolested at Leyden, in the Netherlands; but despairing of realizing their ideal community there, a selected group of them sailed in 1620 in the *Mayflower*, a 180-ton vessel, for America, reaching Cape Cod headland after a nine weeks' voyage. Living at first as a small communistic settlement, under the famous Mayflower Compact, they adopted ownership of private property the third year. The most influential years of the colony were from 1620 to 1660, when under the leadership of men like Bradford, Standish and Brewster, it developed its political ideal. The colony existed as a separate state until 1691, when it was incorporated with Massachusetts. See CONGREGATIONALISM; CONGREGATIONALISTS.

PILGRIM'S PROGRESS, THE, a Puritan allegory by JOHN BUNYAN; published 1678. Written in a style that is austere yet capable of rising to magnificent heights of religious fervor, this tale presents in a dream an allegory of salvation, the chief character of which is the typical CHRISTIAN who, quitting the City of Destruction, travels the strait and stony path to the New Jerusalem, carrying a pack of Sins, charted by his Bible, guided by "Evangelist," past giants of Doubt and monsters of Sin, across the deep stream Death, till at last he enters the Celestial

City. A second part, dealing with the Progress of Christian's wife, "Christiana," and her children, was printed in 1684.

PILLAGE, the plundering or spoilation of goods and property within the territory of an enemy. It amounts to the destruction or devastation of the country by the invader. Such destruction as is allowed under the laws of war must be for the accomplishment of a definite military end.

PILLAR, in mining, a wall of rock, ore or coal, left between two excavations for ground support. If it protects one mine from the standing water in an adjacent mine, it is termed a barrier pillar. Sometimes any abnormally big pillar is termed a barrier pillar. See also ROOM-AND-PILLAR; BORD-AND-PILLAR; GROUND SUPPORT.

PILLARS OF HERCULES, a classical description of the Straits of Gibraltar. See BAAL.

PILL BUG, the common name for members of a crustacean order (Isopoda), called also sow bug. Close relatives of the lobsters and crabs, the pill bugs are not true bugs, although they are somewhat beetle-like in appearance. There are over 2,300 species in the order, most of which live in the sea. Some forms, however, are found in fresh water, and the most familiar species are dwellers in moist places on the land.

Their bodies may attain almost an inch in length. They have seven pairs of walking (thoracic) legs and two pairs of antennæ. The female has a brood pouch for her eggs on the under side of her body.

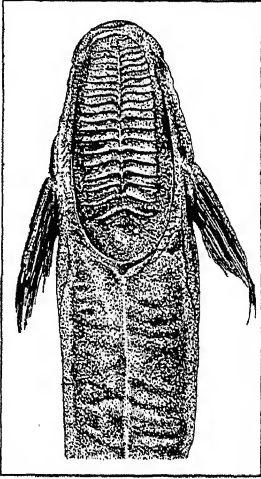
Some of the marine species are parasitic on fishes or larger crustaceans. Others are free swimming, and the gribbles are wood-boring pests. A familiar American terrestrial form, *Armadillidium vulgare*, is found everywhere under stones and wood in damp places. It can roll up in a ball like an armadillo.

The name pill bug is sometimes restricted to the *Armadillidium*, and that of sow bug to the *Oniscida*.

PILLNITZ, DECLARATION OF, Aug. 27, 1291, a declaration issued by the Emperor Leopold of Austria and Frederick William III of Prussia, after the failure of the flight of the King and Queen from Paris, to intervene in behalf of their fellow monarch, Louis XVI of France. If the other Powers would join with them they would use the necessary force to enable Louis "to lay down the basis of a monarchical government adapted to the rights of sovereigns and the well-being of the French nation." Although rather indefinite, it was looked upon in Paris as a direct threat to the Revolution and contributed a good deal to the fall of the Constitutional ministry, the advent of the Girondists (see GIRONDINS) to power and the declaration of war upon Austria in Apr. 1792.

PILOT FISH (*Naukrates ductor*), a celebrated fish of the POMPAÑO family (*Carangidae*) found well offshore in tropical and subtropical seas. It attains a length of 2 ft. and in appearance resembles the mackerel, though lacking the small finlets back of the dorsal and anal fins. In color it is bluish with several dark transverse bands that pass entirely around the body. The pilot fish is said to be very delicate eating,

but is rarely found in the markets. From its habit of associating with sharks and ships, the pilot fish has long been thought by sailors to act as a guide to both, but it is probable that it follows any large object for protection and chance scraps of food. Common in the Mediterranean, this fish was regarded as sacred by ancient seamen, who believed that it not only guided their vessels but disappeared suddenly to warn them of their nearness to land.



PILOT OR SUCKER FISH
Showing ventral surface with
sucking apparatus

PILOTY, KARL VON (1826-86), German historical painter, was born at Munich, Oct. 1, 1826. His genre piece, *The Wet Nurse*, 1853, caused considerable excitement because of the originality of its style, and soon Piloty received a commission from Maximilian II for some historical canvases. His later work was largely in this field. As professor of art at the Munich Academy he exerted considerable influence upon the younger German realists. Piloty died at Munich, July 21, 1886.

PILSEN. See PLZEŇ.

PILSUDSKI, JOSEPH (1867-), Polish marshal and Prime Minister, was born at Zulow, district of Wilno, Mar. 19, 1867. A revolutionist under the Czar, he led the struggle of the Polish Socialists for the independence of Poland. Pilsudski formed the Polish Legion with which he joined Austria at the outbreak of the World War. Resigning the command in Sept. 1916, he became Minister of War in the New Polish State and in Nov. 1918 was elected Chief of State and Commander-in-Chief with the title of Marshal of Poland. In May 1926, he again took command of the army, overthrew the feeble and incompetent government, ignored parliament and seized power. As virtual dictator he directed the government with the aid of ministers appointed by himself until 1928 when he resigned as Premier. In 1930 he again became Prime Minister.

PIMA, a division of the Piman family of North American Indians living in the valleys of the Gila and Salt rivers in southern Arizona. According to tradition the present Pima tribe is descended from a chief who was the sole survivor of a tremendous deluge. He and his descendants prospered and built many large defensive villages of adobe, including Casa Grande. A section of the tribe seceded from the main body and went south where they became known as Pimas Bajos or the Nevome. The present Pima, or Pimas Altos, soon declined due to raids from neighboring tribes. They fled to the mountains and when they returned to the valley built only dome-shaped habitations of pliable poles covered with

mud and thatch in which they still live, although their original dwellings were adobe buildings. The Pima women do all the work except the actual hunting, plowing and sowing. They are expert at winnowing grain and in the making of water-tight baskets. Their husbands ride while they walk and frequently carry heavy burdens. Marriage is entered into without ceremony and may be ended with equal ease. The number of wives is limited only by a man's ability to support. The Pima are a peaceful people though not lacking in courage when attacked.

PIMENTO, the Spanish name for the ALLSPICE, a highly aromatic tree native to tropical America, yielding the well known condiment used in cookery and medicine.

PIMPERNEL (*Anagallis arvensis*), called also poor man's weatherglass, a small annual herb of the primrose family, sometimes planted in gardens. It is a native of Europe and Asia which has accompanied the peoples of western Europe in most of their migrations to other parts of the world. In North America, the pimpernel is naturalized in waste places from Newfoundland to California and southward to Mexico. The pimpernel is a smooth diffuse plant, with four-sided branches, oblong, opposite leaves, black-dotted beneath, and small scarlet (sometimes blue or white) flowers, with a darker center, opening only in bright sunshine, and closing upon the approach of storms.

PINAFORE, H.M.S., a comic-opera by SIR ARTHUR SULLIVAN, libretto by W. S. Gilbert; première, London, 1878, New York, 1879. It is one of the most popular of the dozen operettas which Sullivan and Gilbert produced in collaboration.

Commanding *H.M.S. Pinafore*, which lies at anchor in Portsmouth harbor, is Captain Corcoran. His daughter, Josephine, is secretly in love with a sailor, Ralph, aboard her father's ship. Consequently when the first lord of the admiralty, the Right Honorable Sir Joseph Porter, falls in love with Josephine he is rejected. Captain Corcoran, greatly depressed, sighs to the moon and is overheard by Little Buttercup, the plump stewardess, who flirtatiously does her best to console him. In the meantime Dick Deadeye, having overheard the plan of Josephine and Ralph to elope, reveals that fact to Captain Corcoran who becomes furious, as does Sir Joseph Porter whom Josephine has promised to marry, to keep him quiet. Ralph is put in irons, whereupon Little Buttercup tells the admiral that she long before had nursed two babies, one a patrician, the other a commoner. Unfortunately the babies were mixed, and Ralph is the patrician, while the captain is the commoner. Sir Joseph accordingly orders the release of Ralph, who is given the ship's command and marries Josephine, while Corcoran and Little Buttercup are united.

PINCHOT, GIFFORD (1865-), American governor and forester, was born at Simsbury, Conn., Aug. 11, 1865. He attended Phillips Exeter Academy and was graduated from Yale University in 1889. A love of trees was with him an obsession, and in order

to study them, he went to Europe from 1889-91 where he attended the *École Nationale Forestière* at Nancy, France, traveled and did field work in several countries. Upon his return to the United States in 1891 he traveled through most of the forest regions, opened an office in New York City as a consulting forester, and for several years thereafter he acted in that capacity in various parts of the United States. He did some investigating work on the national forests for the United States government in 1896, and as a result forest reserves were created and their administration placed under the department of the interior. Pinchot in 1898 was appointed chief of the new division of forestry which in 1901 was enlarged into a Bureau of Forestry. Its name was again changed in 1905, this time to the Forest Service when the responsibility for the national forests was placed with the Department of Agriculture. The Forest Service was a model of governmental efficiency and of useful work. Pinchot was repeatedly a member of government commissions including Public Lands, 1903, and Inland Waterways, 1907. He was dismissed by President W. H. Taft in 1910 for publicly assailing the administration of public lands by Secretary of the Interior, Richard A. Ballinger, as contrary to the best interests of conservation and to the public welfare. The quarrel attracted nation-wide attention and public sympathy was principally with Pinchot. Roosevelt during his presidency actively cooperated with Pinchot in a vigorous effort to conserve the various natural resources of the United States; and the latter in 1910 became president of the National Conservation Association, after he had importantly participated in its formation as chairman of the National Conservation Commission, 1908. He vigorously supported Roosevelt's unsuccessful candidacy for the Republican presidential nomination in 1912 and afterwards aided in the formation of the Progressive Party in Pennsylvania. He was defeated as the Progressive candidate for the United States Senate, 1914. With the disintegration of the Progressive Party, 1916, he resumed his Republican allegiance but with a maintenance of his independence of thought and action, and with a continued opposition to the subservience of public officials to the necessities of political party machines. He was appointed State Forester of Pennsylvania, 1920 and from 1923-27 was Governor of Pennsylvania. He reorganized the state government and established a budget system. With the reform elements in the state and with organized labor, because of his settlement in 1923 of a coal miners' strike by arbitration, he was extremely popular, but the Republican political machine disapproved of his reform activities. In 1926 in a three-cornered contest for the Republican senatorial nomination between E. S. Vare, George W. Pepper and Pinchot, which was notorious for extravagant campaign expenditures by all three, Vare was nominated and subsequently elected. Pinchot founded the Yale School of Forestry at New Haven, and the Yale Summer School of Forestry at Milford, Pa., and

He is the author of numerous books on forestry and conservation. In 1931 Pinchot again became Governor of Pennsylvania.

PINCKNEY, CHARLES COTESWORTH (1746-1824), American statesman, was born at Charleston, S.C., on Oct. 26, 1746. During the Revolutionary War he served in the southern campaign under Gates. He was imprisoned by the British during 1780-83. At the Constitutional Convention of 1787 he proposed the Pinckney Plan for the formation of the Federal Constitution. Although the plan was not the foundation of the document, his ideas were partially carried out in the final draft. Serving as governor of South Carolina in 1789-92, he presided at the convention which drew up the new state Constitution in 1790. He was elected for two terms, 1792-96, to the lower house of the state legislature, was governor in 1796-98, and United States Senator in 1799-1801. Appointed minister to Spain in 1801, his indiscreet conduct caused his recall in 1805. He served as governor of his state again in 1806-08 and as a member of the House in 1819-21. Pinckney died at Charleston on Oct. 29, 1824.

PINCKNEY, THOMAS (1750-1828), American statesman, was born at Charleston, S.C., Oct. 23, 1750. He attended Westminster School at Oxford, England, and was graduated from Oxford University. He also attended the French Military College, Caen, France, for one year. He studied law at the Inner Temple, London, and was admitted to the bar in 1774. He returned to South Carolina the same year and began practice in Charleston.

Pinckney supported the revolutionary cause and in 1775 was commissioned a captain of engineers, First Regiment Continental Army. He was promoted to the rank of major in the Florida campaign of 1778. He served as an aide with General Benjamin Lincoln in 1778 and 1779, and in the same capacity with Count d'Estaing in 1779 at the siege of Savannah where Pinckney distinguished himself for efficient handling of his troops. In the defense of Charleston and while acting as an aide to General Gates at the battle of Camden, Aug. 16, 1780, Pinckney was wounded and captured. He was held in Philadelphia as a prisoner of war for one year. He was Governor of South Carolina, 1787-89; he supported the proposed Federal Constitution and in 1788 presided over the South Carolina Convention which ratified it. He was member of the state House of Representatives, 1791, and Washington appointed him U.S. minister to Great Britain, Jan. 12, 1792, in which position he served until July 28, 1796.

From Nov. 24, 1794 to Nov. 1795 Pinckney acted as envoy extraordinary to Spain. In that capacity he negotiated the Treaty of San Lorenzo (1795) which is commonly known as the Pinckney Treaty. It was of utmost importance, since it recognized the American claim to the 31st parallel as the southern boundary of the United States, and opened the Mississippi to the navigation of American vessels as far as the river's

Orleans. He was recalled as minister to Great Britain at his own request. Pinckney was elected as a Federalist to fill a vacancy in the fifth Congress and was reelected to the sixth Congress, serving in the House from Nov. 23, 1797 to Mar. 3, 1801. He resumed the practice of law in Charleston and also engaged in agricultural pursuits. At the outbreak of the War of 1812, Pinckney was appointed major general, serving throughout the war, and at its close he again retired to private life. He succeeded his brother Charles Cotesworth Pinckney as president general of the Society of the Cincinnati, 1825-28. He died in Charleston, Nov. 2, 1828.

PINDAR (c. 522-c. 443 B.C.), Greek lyric poet, was born at Cynoscephalae, in Boeotia, of an ancient and noble family, the Aegidae. He was given a thorough musical education, first by his father, a flute player, later by Lasus of Hermione. His career as a poet began early; at 20 he composed an ode (the 10th Pythian) on a Thessalonian boy's victory at the games, which already showed evidence of genius. From Thebes in Boeotia, his adopted city, his renown spread far and wide, and by the time of the Persian War, Pindar had become the national lyrical poet of Greece. He was venerated throughout the land, for his profound piety toward the gods, as well as for his eminence in his art. Long after his death, at the sacred banquet at Delphi called the *Theoxenia*, the herald used to proclaim: "Let Pindar pass in to the banquet of the god!" For composing a poem in praise of Athens, bitter enemy of Thebes, Pindar was censured by the Thebans, but received high honors from the grateful Athenians. The poet died at Argos, probably in 443 B.C.

Although Pindar's poetry is mainly Dorian in form, in spirit it is truly Panhellenic, like that of his great contemporary, Simonides of Ceos. He was a remarkably versatile writer: his works cover almost the entire domain of lyric poetry, as is shown by the extant fragments of his hymns, paeans, processional songs, songs of praise, choral songs for maidens, choral dance-songs, drinking-songs, dithyrambs and dirges. Besides the fragments, we have, virtually complete, 4 books of *Epinicia* or *Odes to Victory*, choral songs celebrating victories at great national games. These contain 14 Olympian, 12 Pythian, 11 Nemean and 7 Isthmian odes. His magnificent style, his beauty of diction, his lofty thoughts and rich imagery, his harmony of metrical form, all these qualities make Pindar a consummate master of his art, one of the greatest figures in classic literature.

BIBLIOGRAPHY.—Latin ed by C. A. M. Fennell, 1893-99; English translations by T. C. Baring, 1875, Sir John Sandys in Loeb Classical Library, 1915, and A. S. Way, 1922.

PINDUS MOUNTAINS, a mountain range in northern Greece extending north and south from the Dinaric Alps to the Gulf of Corinth, dividing Greece into eastern and western parts. The mountains, which culminate in the peak of Veluchi to reach a maximum height of 7,600 ft., are very rugged and support a pastoral population. In the range, which is the water-

shed for many rivers, are dense forests of beech and oak which have remained untouched for centuries. In ancient times the Pindus Mountains separated Epirus from Thessaly. To-day the name is frequently used to include the Albanian Mountains to the north.

PINE, the name of any member of the genus *Pinus*, of the family *Pinaceae*. Pines are evergreen trees or shrubs, bearing cones, and characterized by the production of dwarf lateral branches each bearing a definite number (1-8, usually 2-5) of needle-like leaves and incapable of further growth. The leaves of each such branch tend to lie parallel with each other and are surrounded at base by a sheath of minute scale-leaves. *Pinus* is an ancient genus best developed during Miocene time, when more than 100 species probably existed, as evidenced by fossil remains. At present about 90 species are known, distributed almost throughout the north temperate zone except in regions of deserts or grassland. They extend north to the Arctic circle and south to Central America, the West Indies, northern Africa, Burma, Sumatra and the Philippines. Along this southern boundary pines are almost exclusively inhabitants of the cooler climate of mountains. Their present center of distribution is in the western United States and northwestern Mexico, where about 40 species occur, some of very localized range; about 15 others are found in eastern North America and the West Indies.

In northern latitudes and the southeastern states pines are usually gregarious, one species or a few together occupying large areas and often producing tall straight trunks free from branches for a considerable proportion of their height. This habit and the strength, durability and lightness of their wood make pines exceedingly valuable sources of lumber. In the northeastern states the magnificent forests of white pine (*P. Strobus*), with trees sometimes 200 ft. tall, were long of first importance; with the gradual depletion of forests the lumber industry moved westward and by the close of the 19th century white pine was nearly exhausted up to its western limit in Minnesota. The industry then turned to the southern states where equally great forests of longleaf (*P. palustris*), shortleaf (*P. echinata*) and loblolly (*P. Taeda*) pines furnish the less valuable wood usually marketed as Georgia pine. In the western states the most important species for lumber are the western yellow (*P. ponderosa*), sugar (*P. Lambertiana*), and western white (*P. monticola*) pines, the latter furnishing much of the lumber now sold as white pine. European species chiefly used as lumber are Scotch (*P. silvestris*) and Austrian (*P. nigra*, often known also as *P. austriaca* or *P. Laricio*) pines; in Japan black (*P. Thunbergii*) and red (*P. densiflora*) pines; in India Nepal pine (*P. nepalensis*). Scotch pine forms extensive forests in northern Europe and Siberia and is widely used in modern forest plantations, being well adapted to light soils of little agricultural value.

Resin and turpentine are obtained from the juice of various species, especially long-leaf and slash (*P. heterophylla*) pines in the southeastern states, maritime

(*P. Pinaster*) and Aleppo (*P. halepensis*) pines in France and the Mediterranean region, and *P. Roxburghii* in northern India. Various species yield seeds, usually known as pine nuts, of considerable value as food, such as *P. Pinea*, the stone pine of southern Europe, and *P. Gerardiana* of northern India, while several species of nut pine, especially *P. monophylla* and *P. edulis*, furnish a highly important food supply for Indians of the Pacific coast. Minor useful products are tan-bark and an essential oil used in medicine.

Numerous species are used for ornament, shade, or wind-breaks in all temperate climates. Those most commonly seen in the colder parts of America are the native white pine and the European Scotch and Austrian pines, while several others are planted in the milder climates of the south and west. *Pinus Mugo* var. *Mughus* is an almost prostrate shrub often used in decorative planting.

In 1930 the total cut in the United States of pine lumber amounted to more than half (53%) of all softwood lumber produced. The United States Census statistics concerning this output are given in the following table:

PINE LUMBER PRODUCTION, UNITED STATES, 1930

Kind of Pine	Total Cut M. Bd. Ft.	Value at Mill. Dollars	States Leading in Production
Lodgepole ..	30,401	536,273	Colo., Wyo.
Sugar	205,159	7,816,557	Calif.
White	1,108,740	30,834,059	Ida., Minn., N.H., Me.
Yellow	7,450,238	155,902,012	Ala., Miss., La., Tex.
Yellow, West'n	2,594,454	61,021,558	Ore., Calif., Wash.

Total 11,389,392 256,110,459

H. A. G.

PINEAL GLAND, or **PINEAL BODY**, a stalked outgrowth of the second of the five divisions of the brain in the vertebrates. In certain lizards it is enlarged and developed into the Pineal eye, which is located in the middle of the top of the skull. Its function is possibly to perceive heat.

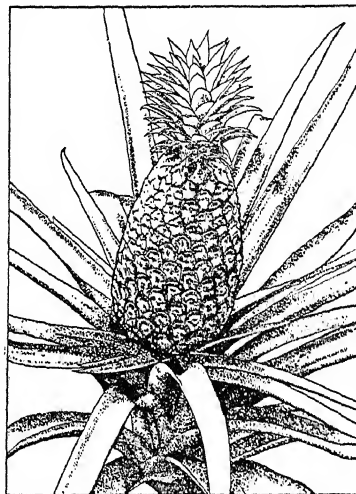
In mammals the structure remains but is much reduced in size. It lies in the medial line at the dorsal surface of the upper part of the brain stem, below and between the cerebral hemispheres (see BRAIN). It is composed of epithelioid cells somewhat resembling those in the glands of internal secretion, together with a considerable bulk of the kind of mossy cells that hold the brain together. In later life mineral matter tends to accumulate within its substance. This is the pineal sand.

This body was supposed by the ancients to be the seat of the soul. In recent times it has been suspected, on conflicting evidence, of being one of the glands of internal secretion but this is not substantiated.

PINEAPPLE, an American tropical herb (*Ananas sativus*), economically the most important member of the pineapple family because of its fruit which is one of the most delicious regularly marketed. Its chief centers of commercial production are the West

Indies, Bahama and Azore Islands, southern Florida, Hawaii, northern Africa and Queensland, Australia.

The first attempts were made to grow the pineapple in the United States near St. Augustine, Florida,



PINEAPPLE

about 1850. Later cultivation became extensive, so that at one time a half million crates annually were marketed. Due to various diseases, cold winters and competitive culture in Cuba, Porto Rico and Hawaii, pineapple growing for the market has been practically discontinued in Florida.

The plant forms a rosette of long sword-shaped leaves close to the ground and sends up a 2 to 4 ft. stem surmounted by a head, the pineapple. Twelve to eighteen months later another stem, developed from the root, will bear another such head. Thus, though no stem bears a second time, the original plant when adequately fed may continue productive for ten or more years. However, better results are usually gained by growing new plants from slips from the bases of the fruits, suckers from the lower axillary buds, ratoons or rooted subterranean buds and sometimes from the tops of the fruits.



FROM JEPSON. MAN. FL. PLANTS CALIF., COPYRIGHT

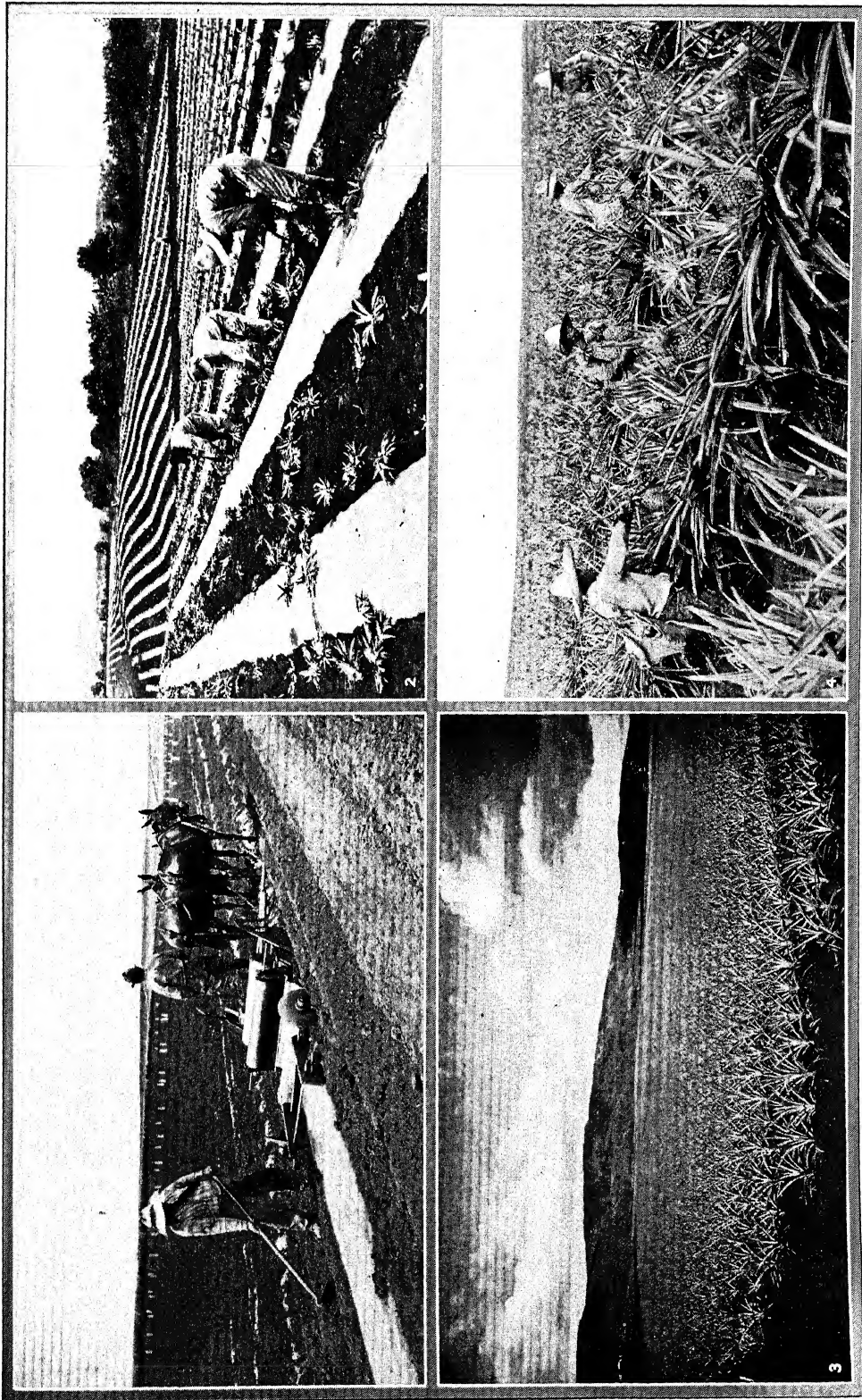
PINEAPPLE WEED
Plant in flower, flower and longitudinal section of head

The pineapple needs porous, well drained soil. The plants require little cultivation beyond the keeping down of weeds.

M. G. K.

PINEAPPLE WEED (*Matricaria suaveolens*), a smooth annual of the composite family allied to the chamomile and sometimes called rayless chamomile.

PINEAPPLE



1-4, COURTESY HAWAIIAN PINEAPPLE CO.

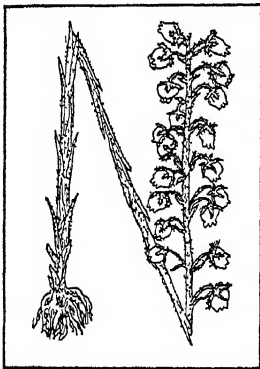
PINEAPPLE CULTURE IN THE HAWAIIAN ISLANDS

1. Covering fertilized rows of soil with mulching paper. 2. Planting the young slips through mulching paper.
3. Field of pineapples after twelve months in the ground. 4. Harvesting by hand; the fruit is bent over and broken at the stem.

It is a native of Europe widely naturalized across North America. Like the DOG-FENNEL, which it somewhat resembles in size and in its finely cut foliage, it is a common weed about farm buildings and along roadways. It differs from the dog-fennel in its rayless flower-heads and in its pineapple-scented foliage.

PINE BLUFF, a city in southeastern Arkansas, the county seat of Jefferson Co., situated on the Arkansas River, about 65 mi. southeast of Hot Springs. It is served by buses, trucks and the Missouri Pacific and the St. Louis and Southwestern railroads. There is an airport, Toney Field. Cotton, corn and fruits are the chief crops of this region. The principal industrial products and interests are lumber, mill work, cotton and cotton seed, mixed feed, auto body parts, and caskets. Here also there are foundries, boiler and machine shops, railroad shops and sawmills. The manufactured output, 1930, was worth \$8,325,367. The retail trade, 1930, amounted to \$14,773,314. The State Colored Normal College, Merrill Institute and the State Industrial School are located here. Pine Bluff, located on a bluff of the river, was founded in 1819; incorporated as a city in 1885. Pop. 1920, 19,280; 1930, 20,760.

PINEDROPS (*Pterispora andromeda*), a purplish-brown, leafless, saprophytic herb of the heath family called also giant bird's nest. It is found in rich woods from Nova Scotia to British Columbia, southward to California and Mexico. The stout, fleshy, sticky hairy stems, rising 1 to 4 ft. high from a thick mass of matted fibrous roots, bear many narrow scales in place of leaves and numerous white flowers in a long spikelike cluster. The plant, commonly found in rich humus under pines, dies soon after flowering, disseminating an immense number of small winged seeds.



P. A. RYDBERG. "FLORA OF PRAIRIES AND PLAINS"

PINEDROPS

PINEHURST, a favorite winter resort in North Carolina, situated about 5 mi. west of Southern Pines and 62 mi. southwest of Raleigh. It is on U.S. Highway No. 1 and North Carolina Highway No. 702 and on the Norfolk Southern Railroad. Pinehurst is in the longleaf pine region of the Sand Hills, 650 ft. above sea level, and enjoys a mild and equable climate during the winter season which lasts from October to May. Thousands of visitors come to Pinehurst during the season attracted by its fine golf links, tennis courts, bridle paths and other recreation facilities. Resident pop. 1930, 1,700.

PINE NUT, the edible, more or less oily seeds of various pines. The nut pine of Europe (*P. Pinea*) bears nutlike seeds (pignons), used as an article of food or as a dessert since Roman times. The stone

pine (*P. Cembra*), of Siberia and central Europe, produces similar edible seeds, as does the Neoza pine (*P. Gerardiana*) of the Himalaya Mountains. Several small pines of the southwestern United States, known as pinons, yield edible seeds. See PINON.

PINE OIL, a colorless, slightly oily liquid, having a pine-like odor. When waste pine wood is steam distilled, pine oil is obtained in addition to wood turpentine; wood rosin is left in the wood, recoverable only by extraction with solvents. Pine oil is used mainly for the frothing agent in froth flotation of ores (see also FLOTATION PROCESS; ORE TREATMENT). It is a good emulsifying agent and detergent, and finds use in laundering. Pine oil should not be confused with pine needle oil or pine wood oil (Kienöl), obtained as a by-product of sulphate wood pulp.

BIBLIOGRAPHY—Thomas Gamble, *Naval Stores Year Book for 1926*, Savannah.

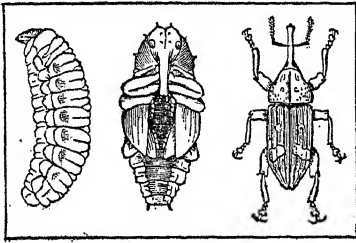
PINERO, SIR ARTHUR WING (1855-), English dramatist, was born at London, May 24, 1855. He started to study law, but at the age of 18, he became an actor, working in that capacity for seven years to learn playwriting from the actor's point of view. After successfully producing twenty-seven farces and sentimental comedies, he wrote *The Second Mrs. Tanqueray*. Produced in London in 1893, this play, followed by other modern social dramas, did much to bring the cultivated British public back to the theater and to prepare audiences for such later dramatists as G. B. Shaw and John Galsworthy. He has written more than 50 plays, including *The Magistrate*, 1895, *Dandy Dick*, *Sweet Lavender*, *The Profigate*, *The Amazons*, *The Notorious Mrs. Ebbsmith*, *The Benefit of the Doubt*, *Trelawney of the Wells*, *The Gay Lord Quex*, *Iris*, *Letty*, *His House in Order*, *The Thunderbolt* and *Mid-Channel*, 1909. He was knighted in 1909.

PINE SNAKE, a popular name for a species (*Pituophis melanoleucus*) of harmless snake, called also bull snake, thunder and lightning snake, and white gopher snake. It lives in the pine woods from New Jersey through Florida, and as far west as Ohio. In the South it is whitish with brown blotches; further north the blotches are black. This snake sometimes grows 8 ft. long. It feeds on rodents and bird's eggs. When disturbed or startled it emits a loud hissing noise.

PINEVILLE, a city in southeastern Kentucky, the county seat of Bell Co. It is situated on the Cumberland River 40 mi. southeast of Corbin; buses and the Louisville and Nashville Railroad serve the city. Corn and tomatoes are the chief crops of the vicinity. Coal is mined nearby. Pineville is a popular summer resort adjoining Cumberland State Park. Pop. 1920, 2,908; 1930, 3,567.

PINE WEEVIL (*Pissodes strobi*), a small beetle of the coleopterous family *Scarabaeidae*. It is reddish-brown in color; about $\frac{1}{3}$ in. in length, and has irregular white blotches on the back. The eggs are laid on the terminal shoots of pine or spruce trees, where they hatch into fat, white, legless grubs, which

bore through the bark into the wood. Indication of the pest is given when the trees turn brown at the tips and die.



PINE WEEVIL
Larva, pupa and adult

PING-PONG, also called Table Tennis, a miniature form of tennis, played on a table. The game is of English origin, an offshoot of lawn tennis and badminton. It is played by two players standing at either end of a table, the regulation size of which is 9 by 12 feet, although a smaller area may be utilized. The game achieved great popularity early this century in England, and enthusiasm for this tennis in miniature spread to the United States. In this country interest in the game subsided after 1902, but it was revived in 1928, and began to enjoy a popularity rivaling miniature golf, pool and billiards.

Although the object of some ridicule, ping-pong or, properly, table tennis, is a game in which only long practice brings the balance, quickness and wrist control needed to engage in match play. A net of between six and seven inches in height is stretched across the table. The players use light wooden rackets of battledore design, sometimes covered with vellum; the balls are generally made of celluloid, about $1\frac{1}{2}$ inches in diameter. The player serving the ball is called the server, his opponent the striker-out. Overhand volleying is not permitted. In England the scoring is similar to that of lawn tennis. In the United States ping-pong is generally scored by points, and game is 20. The players may return the ball to any point across the net; failure to return, or returning a ball beyond the table, scores a point for the opponent. Service goes to the winner of each rally. The first national ping-pong championship in this country was held by the American Ping-Pong Association at New York City in Mar. 1931.

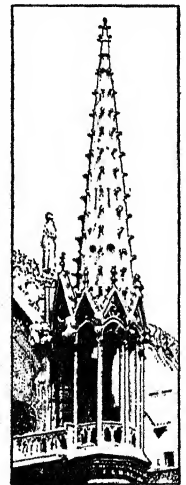
PINK, the common name for a large genus (*Dianthus*) of plants of the pink family, many of which are extensively grown for their showy flowers. There are about 200 species, most numerous in the Mediterranean region and widely distributed in other parts of the world. They are mostly perennial herbs with narrow, usually grasslike leaves and large red, pink or white flowers borne singly or in clusters. According to L. H. Bailey, the pinks commonly grown in North America may be classified in five main groups: 1. annual pinks, derived from the China pink (*D. chinensis*) with large, slightly fragrant flowers running into double forms with vivid colors; 2. the clove or carnation pinks, developed from *D. Caryo-*

phyllus, including numberless garden and glasshouse varieties; 3. the grass pinks, small tufted, very fragrant perennials derived from *D. plumarius*, the common garden pinks; 4. the maiden pinks (*D. deltoides*), densely tufted profusely flowering plants forming broad mats; 5. the glomerate pinks, as the SWEET WILLIAM (*D. barbatus*), bearing numerous brightly colored flowers in dense heads. See CARNATION.

PINKERTON, ALLAN (1819-84), American detective, was born at Glasgow, Scotland, Aug. 25, 1819, and came to the United States in 1842. In 1850 he opened a detective agency in Chicago, Ill., which grew into an international organization. He guarded President Lincoln on the inaugural journey to Washington, D.C., and organized the U.S. secret service. In 1866 he recovered \$700,000 stolen from the Adams Express Co. and his agents in 1876 drove the Molly Maguire murderers from the Pennsylvania coal-fields. Pinkerton died at Chicago, July 1, 1884.

PINKNEY, WILLIAM (1764-1822), American statesman, was born at Annapolis, Md., on Mar. 17, 1764. After studying law he practised in Hartford County, Md., and in 1788 was a member of the state convention which ratified the Federal constitution. The years 1796-1804 he spent in England arbitrating claims of American merchants under the Jay treaty of 1794 and in 1806 with Monroe he conferred with England about the capture of neutral ships. He served as minister to Russia in 1816-18 and in 1820 was elected to the United States Senate by the Democratic party. Before the bar of the Supreme Court he proved himself one of the most talented lawyers of the day. He died at Washington, Feb. 25, 1822.

PINNACLE, a decorative structure to crown an architectural form, especially one which crowns the top of a buttress. As every pound of weight added to a buttress increases its efficiency, the rich tall pinnacles of Gothic architecture serve a structural as well as a decorative function. Early Gothic pinnacles were simple solid masses of masonry crowned usually with a gabled roof. Later, as their usefulness and their beauty were realized, they were made taller, usually decorated with arcades and crowned with a small spire. Developed pinnacles, especially in France, are often of great richness, and may take the form of a shrine over a statue, as in Reims Cathedral, about 1240. See GOTHIC ARCHITECTURE.



PINNACLES NATIONAL MONUMENT, a region of wild and rugged scenery and fantastic examples of rock erosion in west central California. The tract was first set aside Jan. 16, 1908 and was enlarged to its present size of 2,980 acres in 1923 and 1924. Spirelike formations of volcanic rock from

A PINNACLE OF
NÔTRE DAME DE
PARIS

600 to 1,000 ft. high are characteristic of the region and have given it its name. A network of caves and subterranean passageways underlies each group of rocks. Animals and birds are abundant. The monument is about 35 mi. by automobile from Hollister on the Southern Pacific or from King City. The main entrance is through a beautiful canyon called Bear Gulch. There are two systems of trails, one through the caves, the other to the highest pinnacles.

PINOCHLE, a card game played chiefly in the United States, where it was evolved from *BEZIQUE* in the 19th century. The game is played by two, three or four players using two packs combined, from which all the cards below the nine are extracted. The object is to score 1,000 points by means of various combinations made by combining the 12 cards dealt the two players (in single pinochle) at the start, with the cards drawn from the stock. The ranking order is ace, 11; ten, 10; king, 4; queen, 3; knave, 2; and nine of trumps, if turned, 10. To declare the various scoring combinations during pinochle play is to meld. These combinations consist of marriage, or king and queen of any suit except trumps, which counts 20; royal marriage, or king and queen of trumps, 40; sequence, or five highest trumps, 150; pinochle, or queen of spades and knave of diamonds, 40; double pinochle, or both spade queens and both knaves of diamonds, 300; grand pinochle, or king and queen of spades and knave of diamonds, 80; four aces of different suits, 100; and similarly four kings, 80; four queens, 60; four knaves, 40. Eight aces score 1,000; eight kings, 800; eight queens, 600; and eight knaves, 400. Following the deal, the first card on the remaining stock is turned up to determine trumps. The non-dealer leads; but the leader's opponent need not take the trick, follow suit or trump. After each player has melded any one of the foregoing combinations, he draws the top card from the stock, thus retaining 12 cards until the stock is exhausted. In the last 12 tricks, both players are obligated to take tricks, follow suit, or trump, if possible.

See R. F. Foster, *The Laws of Pinochle*.

PIÑON, the Spanish name for four species of nut pines (*Pinus*) found chiefly in arid districts from Colorado to California and southward to northern Mexico. Of these the northern piñon (*P. edulis*), a tree sometimes 50 ft. high, is the most important and widely distributed. The sweet, edible seeds, forming a much used article of food among the Indians, are marketed in the towns of southern Colorado and New Mexico. The much smaller single-leaf piñon (*P. monophylla*), found in Nevada and California, yields seeds used by the Indians, as does the Parry piñon (*P. Parryana*) in Lower California. The Mexico piñon (*P. cembroides*), with large oily seeds, is marketed in large quantities in northern Mexico. By some authorities these four piñons are regarded as varieties of *P. cembroides*.

PINON JAY (*Cyanocephalus cyanocephalus*), a small bird of western North America, allied to both the crows and the jays, frequenting foothills covered

with piñon pines. It is about 10 in. long and crow-like in form, with dull bluish gray plumage enlivened with intense blue on the neck and head. Restless and noisy, it moves in large flocks, uttering harsh crowlike calls and feeding chiefly upon piñon seeds. It nests in piñon trees, laying 4 or 5 bluish-white eggs.

PINS, a term when strictly used refers to small pegs of metal or wood; popularly, it refers to small slender metal rods pointed and headed, used in fastening fabrics and paper. They are usually made by machines which cut the wire (brass, steel or other material) into the proper length, and form the head and the point.

PINT, a unit of dry and liquid measures of capacity, equivalent to one-eighth of a GALLON in both cases. In APOTHECARIES' MEASURE it comprises 16 fluid ounces.

PINTAIL (*Dafila acuta*), a common fresh-water duck distinguished by its long slender neck and the greatly elongated central tail feathers of the male. It is widely distributed in the Northern Hemisphere, wintering southward to Central America, the Mediterranean countries and India; in North America it breeds from the northern states northward, occurring most numerous in the interior. In color the male, somewhat over 2 ft. long, is narrowly waved with black and white above, olive-brown on the head, a green wing patch and white neck, breast and underparts; the female is smaller with chiefly mottled brown plumage. The pintail feeds on various aquatic plants and animals and nests on the ground, sometimes far from water, laying 6 to 10 olive-tinted eggs. Though quiet at day it chatters noisily at night, the female quacking like the common duck, but the male peeping like the tree toad (*Hyla crucifer*).

PINWORM, the popular name for a species (*Oxyuris* or *Enterobius vermicularis*) of threadworm which is a common parasite in the digestive tract, especially the rectum, of man. The females are about 10/25 of an inch, and the males 4/25 of an inch in length. When the eggs are laid they may contain infective larvæ. Man becomes infested either by drinking contaminated water, or through the hands.

The presence of the worms causes anemia and local irritation. Enemas containing solutions of carbolic acid, quassia, turpentine, vinegar or salt, and mild purgatives should be given. See also THREADWORM.

PIONEERS, in a military sense, engineer troops assigned to assist an advancing or a retreating force by utilization of quick expedients of construction, fortification or demolition. Their principal spheres are, during any advance, the repair of bridges, fords or ferries and removal of road obstructions, and during a retreat, demolition and creating obstructions to the pursuing enemy.

PIOTRKOW, a city in the Polish voievodship of Lodz, 90 mi. southwest of Warsaw, on the railroad between Warsaw and Czestochowa. It has castle ruins, a court of appeals, and advanced schools. Manufactures include glass, earthenware, leather and agricultural implements. A very old Polish city,

Piotrkow has been the place of election of many kings as well as the location of Diets. Pop. 1921, 41,113.

PIOZZI, HESTER LYNCH (1741-1821), English writer, noted for her friendship with Dr. SAMUEL JOHNSON, was born at Bodvel, Carnarvonshire, Wales, Jan. 16, 1741. She received an excellent education and in 1763 married Henry Thrale, a wealthy brewer who possessed a luxurious house at Streatham, near London. In this home she soon gathered about her a circle of intellectual men and women, of whom Dr. Johnson was the leading member. With deep appreciation of the ease and luxury the Thrales offered, he paid them frequent and lengthy visits, becoming practically a member of their household. On Thrale's death in 1781, he assisted Mrs. Thrale with her business affairs. The marriage of Mrs. Thrale to an Italian musician, Gabriele Piozzi, in 1784, so incensed Dr. Johnson that he burned every letter he had received from her. In 1809 Piozzi died, but his widow retained all her sprightliness and in her old age held William Augustus Conway, an actor, in much affection. She published in 1786 her *Anecdotes of the late Samuel Johnson*, a lively account of this historic friendship. Mrs. Piozzi died at Clifton, May 2, 1821.

PIPE AND TUBE MANUFACTURE. Pipe and tube may be manufactured by the following processes: (1) welding, (2) piercing and rolling a billet, (3) cupping, (4) extrusion and (5) cold finishing.

Welding. The lap-weld process was first developed in England in 1812 for the manufacture of wrought iron gas pipe. A strip of steel, or "skelp," with beveled edges and heated to about 1600° F. is roughly formed in the shape of a pipe with the edges slightly overlapping. The bent skelp, heated to a temperature of about 2500° F., is then passed through a pair of circular rolls, a mandrel, called "welding ball," passing through the skelp so that the overlapping edges are pressed together between the rolls and the mandrel. This operation forms the weld. The pipe is then passed through another set of circular rolls without a mandrel to give the required outside diameter and then goes through straightening and finishing rolls.

Butt-welding was invented in England in 1824 by James Russell and Cornelius Whitehouse. In this process the skelp is rolled with square edges and



COURTESY NATIONAL TUBE CO

FIG. 1

Diagram showing tubing section, where bent skelp is bent and welded as shown through the welding ball.

brought up to welding temperature on the flat hearth of a regenerative furnace. It is then drawn from the furnace through a die, or "welding bell," as indicated in Fig. 1. The skelp is bent and welded in one operation. After welding, the pipe is passed through siz-

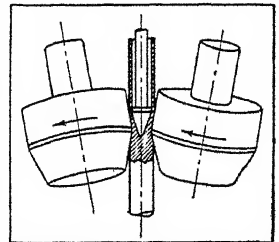
ing and finishing rolls the same as in lap-welding. Butt-weld pipe is made up to 4 in. diameter and, for the smaller sizes, at the rate of about 1,000 pieces per hour.

Electric and Gas Fusion Welding Processes. Fusion welding, including electric and gas fusion and electric resistance welding, has been developed in recent years for the manufacture of steel pipe. In electric fusion welding, an arc formed with a bare or flux covered steel electrode supplies the heat and metal to be deposited. The edges of the steel plates are planed parallel, beveled and bent in a special machine. In some cases the edges are "tacked" in position by spot welding before being transferred to the welding machine. In the final welding operation, the travel of the pipe, electric current, and feed of the electrodes are all under automatic control. More than one electrode may be operating on a length of pipe at once. Pipe may be made up to 7 or 8 ft. in diameter by this process by using two semi-circular formed plates and two seams. In carbon arc welding, the arc is formed between a carbon electrode and the steel to be welded, fusing the welding wire into the joint.

Gas fusion welding is used on plates similarly prepared, the heat being supplied by an oxy-acetylene gas flame. The metal required to fill the seam is supplied by welding rods. The principle of operation is much the same as under electric fusion welding and is usually automatic.

Resistance welding has been recently applied to the manufacture of steel pipe in long lengths. Current is passed across the abutting edges of the pipe, the resistance causes intense heating of the metal and the weld is obtained by forcing the edges together at the proper temperature. The thickness of plate that can be welded by this process is limited.

Piercing and rolling a steel billet is the most generally used process for the manufacture of seamless steel pipe, and is used to some extent for non-ferrous metals. In steel pipe manufacture, ingots are rolled into blooms and then into rounds, usually from 3 to 12 in. in diameter. After removal of flaws the rounds, hot sawed to the required length, are reheated to a temperature of about 2200° F. and pierced. In this process the hot round is rotated, and by the angularity of the piercing rolls, fed through lengthwise and forced over a mandrel as shown in Fig. 2. As the billet is rotated and advanced a hole is formed and the metal caused to flow over the mandrel, which serves to regulate the size of the hole. Sometimes the hole is enlarged by passing through a second piercing mill. After the piercing operation the tube is elongated and its wall thickness reduced by passing over a

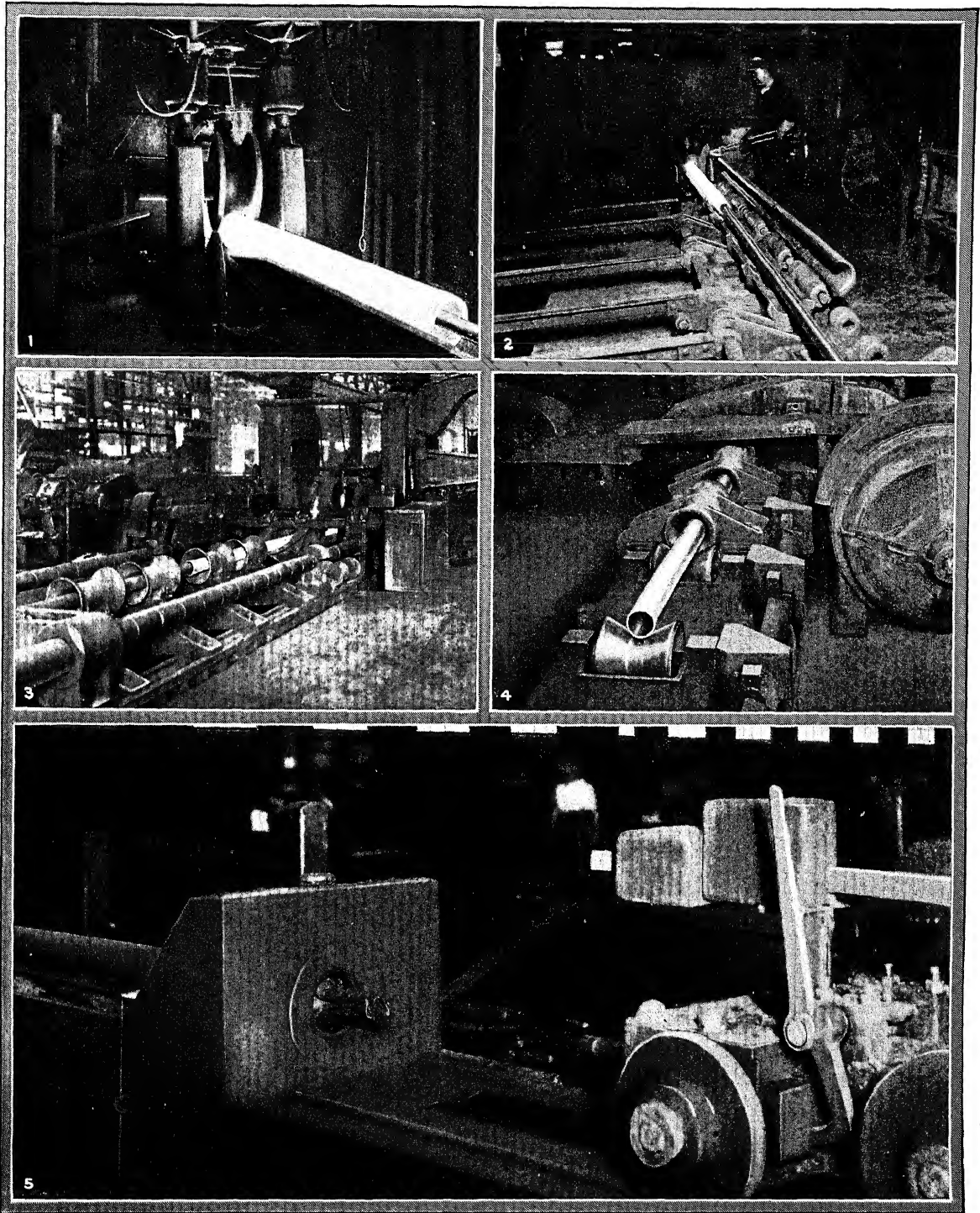


COURTESY NATIONAL TUBE CO

FIG. 2

Diagram showing arrangement of rolls and mandrel in diagonal rolling process employed in roll piercing

PIPE AND TUBE MANUFACTURE



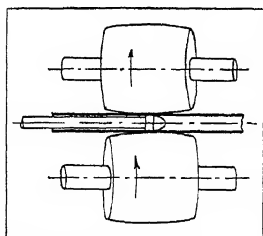
COURTESY NATIONAL TUBE CO.

PIPE MANUFACTURING PROCESSES

1. Pipe being welded by passing through the lap-welding rolls over the mandrel. 2. The roll piercer, showing a pierced billet coming from the mill. 3. Rolling mill, mandrel side, showing the mandrel bar and guides passing

through the mill. 4. Tube entering the reeling machine. 5. Die for cold rolling tubes, showing pointed end of tube projecting through the die preparatory to attaching tongs. The drawing tongs are shown at the right.

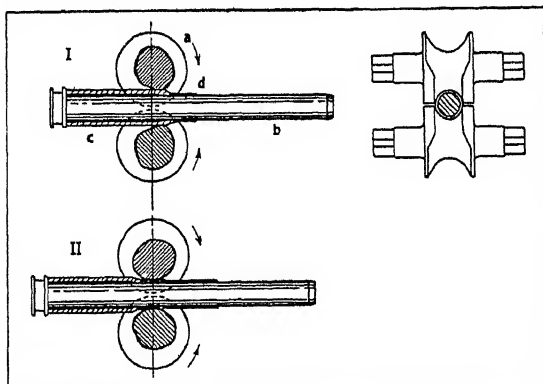
mandrel and between grooved rolls in what is known as an automatic or Swedish mill. The tube is then put through a set of cross rolls with a mandrel, known as a reeling machine (see Fig. 3) which reduces the wall thickness slightly and improves the finish. Seamless steel tubes are made up to 24 in. diameter in 40 ft. lengths by this process.



COURTESY NATIONAL TUBE CO

FIG. 3. ROLLS FOR REELING MACHINE

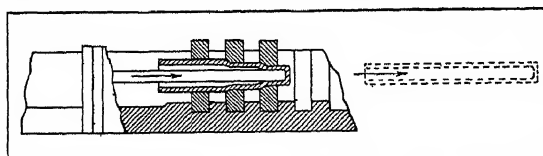
Pilger process. In this process the round billet is first pierced as described above, then reheated and passed through a pair of swaging rolls on a mandrel so that the thick wall is reduced to the required dimensions step by step. In this process the pierced blank is reduced to the thickness required by one set of rolls having a complicated and variable section as shown in Fig. 4. The rolls revolve against the passage of the tube. The pierced bloom is held on a mandrel and is moved forward



COURTESY NATIONAL TUBE CO

FIG. 4. DIAGRAMMATIC SKETCHES OF THE PILGER PROCESS
a, Working rolls b, mandrel of Pilger mill. c, sleeve bloom. d, drawn down part of the bloom. Sketch I shows the rolls beginning to grip the bloom, II the drawing down of the part seized. An end view of the rolls is shown at the right

slightly at each revolution of the roll and at the same time, rotated 90°. After passing through the Pilger mill rolls the tube is sized and straightened.



COURTESY NATIONAL TUBE CO

FIG. 5

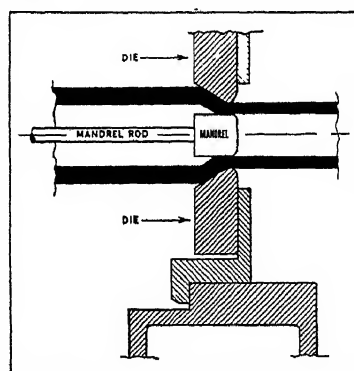
Diagram illustrating the principle of the hot draw bench. The tubing is drawn by passing it through successively smaller dies

Cupping process, one of the oldest methods of making seamless tubes, is still used in the manufacture of both ferrous and non-ferrous tubing. A disk of metal is first hot punched out of a plate and formed by means of a press and mandrel into a cup. The cup

is reheated and given another press operation with a smaller mandrel and die. After reheating it is forced by a plunger through several dies of decreasing diameter as illustrated in Fig. 5. This operation is commonly used in the manufacture of seamless high pressure gas cylinders.

Push bench process enables a great increase in speed of production of tubes up to about 8 in. diameter. Short square billets are heated and dropped vertically into the circular container of a powerful hydraulic press, having a diameter slightly greater than the diagonal measurement of the square billet. The ram is forced into the billet, altering its shape from square to a round thimble-shaped blank with inside diameter equal to that of the finished tube. The hot blank is then rapidly pushed forward through 10 or 12 ring dies with decreasing diameters and the wall thickness is successively reduced. The tube with the mandrel bar inside it is then passed through a reeling machine where the pipe surface is smoothed and the bar is loosened. After cutting off the cupped end, the tubes are rolled down to the required diameter.

Extrusion has been used widely in the manufacture of non-ferrous tubing, such as aluminum, lead, copper and brass, and to a limited extent in steel tubing manufacture. The metal is first cast or rolled into a cylindrical bar and cut to length. A hole is drilled partly through the axis of the bar. It is then heated to a suitable temperature and inserted in the cylindrical container of a strong press. At the bottom of this container is a die with an opening equal to the outside diameter of the tube. A plunger is brought down into the container in contact with the heated metal. A punch is then driven through the heated blank until it passes into the opening of the die forming the annular ring through which the metal flows. The plunger is then forced down and the hot metal flows out of the container in the form of a tube.



COURTESY NATIONAL TUBE CO

FIG. 6. DIAGRAM SHOWING RELATIVE POSITION OF DIE AND MANDREL IN COLD DRAWING OF TUBING

Cold finishing tubes. This process is used in the manufacture of better finished steel tubes with close dimensions or tubes smaller than 1½ in. diameter. The ends of the hot finished tubes are swaged down so that the swaged portion will pass through a die. The

end of the tube is then grasped and the tube pulled through the die and over a mandrel, as illustrated in Fig. 6. Both the die and the mandrel are coated with a suitable lubricant. The tube may be given three or four passes in this way, after which it is annealed at a temperature of about 700° C. to remove the drawing strains. A finish anneal may be given in order to obtain the required physical properties. Non-ferrous metals are usually finished by cold drawing.

Hot drawing and reducing mills consist of trains of rolls often with their axes arranged alternately at right angles to each other through which the hot tube is passed and reduced in diameter usually with a slight thickening of the wall. Such mills are convenient for making sizes less than 1½ in. diameter, below which it is at present not practicable to make seamless tubes by the direct process. F. N. S.

PIPEFISHES, a numerous genus (*Syngnathus*) of tuft-gilled fishes, closely allied to the seahorses. They are exceedingly curious small fishes, with a very slender, six- or seven-sided body tapering into a long tail and armed with rings of bony plates; a long tubular snout ending in a small toothless mouth; small fins, and gills composed of small, rounded tufts. The male possesses a pouch on the under side of the tail in which the eggs are placed, fertilized and retained until the young are able to shift for themselves. Pipefishes inhabit the warmer seas, although sometimes entering fresh water, and are usually found in shallow bays among the eel-grass and algae, where they feed largely upon small crustaceans, mollusks, insects, marine worms and fish eggs. The common species of the Atlantic coast is the northern pipefish (*S. fuscus*), ranging from Halifax to North Carolina. It is usually 4 to 8 in. long and, though its color varies with its surroundings, is generally greenish or olive above with darker bars and mottlings. See also SEA HORSE.

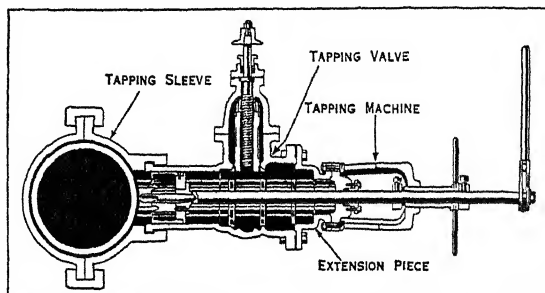
PIPE LINES FOR OIL AND GAS, conduits formed by joining iron, cast-iron or steel tubes end to end to form a continuous pipe. They are used for conveying oil or gas from a source of supply to a refinery or to the point of consumption. Oil and gas are transported several hundred miles by pipe lines, the longest line extending from the Oklahoma fields to Chicago and Minneapolis, a distance of 1,400 miles. The lines are laid across mountains, streams and ravines, and the oil or gas is forced through them by pumps located at intervals along the length.

Welding is the modern process of joining sections of pipe, both electric-arc and oxy-acetylene welders being employed. The old methods of joining pipe by threaded, flanged or riveted connections is still used to a large extent, however. Formerly, sections used in pipe lines were made by forming sheet metal into cylinders and riveting the edges together, now manufacturers are supplanting this method by WELDING.

PIPESTONE, a city in southwestern Minnesota, the county seat of Pipestone Co., situated 50 mi. northeast of Sioux Falls, S.D. Bus and truck lines and four railroads serve the city. There is an emergency landing field. Pipestone lies in a rich agricultural

region producing grain, flax, cattle, hogs, poultry and dairy products, for which the city is a market center and shipping point. There is an old pipestone quarry here. The city is the seat of a Government Training School for Indians. Many tribes used to gather here to obtain pipestone, and the surrounding countryside is rich in Indian legends. Pipestone was settled in 1874 and incorporated in 1879. Pop. 1930, 3,489.

PIPE TAPPING MACHINES, devices for making connections to cast iron water mains under pressure and without interrupting service. For house connections "corporation" cocks are inserted with a machine temporarily fastened to the main, but cast



COURTESY A. P. SMITH MFG. CO.

PIPE TAPPING MACHINE

iron connections are made through a permanent flanged valve fastened to a flanged split sleeve previously bolted on the main and tightly "calked." The machine is bolted to the valve through which, when opened, a cutter removes a disk of the proper size from the main. The cutter is withdrawn, the valve closed, the machine removed and the new pipe extension connected to the flange of the valve.

PIPISTRELLE (*Pipistrellus pipistrellus*), a naked-faced bat, one of the smallest, most abundant, and most familiar of Europe, reddish-brown above, paling to gray below. During the day pipistrelles hide in any fitting place. At nightfall they comb the air for insects. They are the first bats to appear in spring and the last to retire in the fall to a semi-torpid state of hibernation, during which they hang in concealment head downward. The mother carries her one or two young clinging to her.

PIPIT, the name given to various small birds of the wagtail family, especially to those of the genus *Anthus*, of nearly cosmopolitan distribution. They resemble the larks in their terrestrial habits, their plain plumage, their long hind claw and their habit of singing on the wing. Like the true wagtails they walk and run, instead of hopping, and constantly jerk their short tails. Pipits usually inhabit open treeless country and feed on insects. Of the two American species the best known is the American pipit or TRILLARK (*A. spinoletta*), distributed almost throughout North America on migration and nesting in the arctic zone. Sprague's pipit (*A. spragueii*), 6 or 7 in. in length, a common bird in the Great Plains, has a very melodious song; it nests on the ground laying 3 or 4 grayish, spotted eggs.

PIPPA PASSES, a lyrical drama by ROBERT BROWNING, published 1841. Pippa, on her one holiday of the year from the silk mills at Asolo, passes through the streets gaily singing a song which is heard by several groups of people, all facing critical moments in their lives, and which influences each of them powerfully for good. The simple Pippa, unconscious of what she has done, returns home, glad of heart and grateful for her holiday.

PIPPI, GIULIO. See GIULIO ROMANO.

PIPPIN. See PEPIN.

PIPSISSEWA (*Chimaphila umbellata*), a low, evergreen, slightly woody perennial of the heath family called also prince's-pine and bitter wintergreen. It is found very widely in dry woods in Europe, Asia and North America. The creeping or trailing stem sends up leafy branches, sometimes a foot high, bearing several white or pinkish flowers marked by a dark pink ring. An extract from the leaves was formerly used in household medicine.

PIQUA, a city in Miami Co., western Ohio, situated on the Miami River, 30 mi. north of Dayton. It is served by bus lines, two electric railways and two railroads. There is an airport. Grain, hay, tobacco, poultry and dairy products are the chief interests of the countryside. Piqua has factories turning out handles, shovels, walnut veneer, strawboard, textiles, furniture, machinery, hearses, stoves and other products. The manufactured output, 1929, was valued at \$19,848,618. The retail business in 1929 amounted to \$8,967,928. Limestone is found in the vicinity. The site was settled by John Gard in 1797; the town was known as Washington until 1816. The name Piqua is that of a division of the Shawnee Indian tribe. Prehistoric earthworks and the old building of an Indian trading post, built in 1749, are landmarks of Piqua. The last battle of the French and Indian War took place here or near here. Pop. 1930, 16,009.

PIRACY, the crime of freebootery or robbery on the high seas; the taking of property from others on the open sea by violent seizure, without lawful authority and with criminal intent. Old laws made engaging in the slave trade or trading with known pirates, piracy. The pirate is the enemy of mankind and is punishable under the Law of Nations by any competent tribunal in any country where he may be found or into which he may be brought. Pirates, however, are not to be killed except in battle, but must be surrendered and given legal trial.

PIRAEUS, also Peiraeus, the port of ATHENS which is only five miles distant and the largest port of Greece, stands on a hilly peninsula with a modern electric railroad connecting the two. In the harbor, one of the best and busiest in the Mediterranean basin, a maritime trade with the world is conducted. The city also is important industrially, with textile-making, macaroni-baking, tanning, distilling and shipbuilding the main industries. Prior to the 19th century it was of no importance commercially but after the rise to prominence of Athens, 1833, docks were built and shipping facilities greatly increased. In ad-

dition to strictly commercial activities there is also a naval training school. Pop. 1928, 251,328.

PIRANDELLO, LUIGI (1867-), Italian dramatist and novelist, was born at Girgenti, Sicily, June 28, 1867. He studied philosophy, which subject he taught until 1923. In 1904 appeared his remarkable *Mattia Pascal*, a semi-metaphysical novel. His dramatic genius, revealed at the age of 45, has produced a unique series of "cerebral" dramas. Noteworthy among them are *Right You Are*, 1916, *Six Characters in Search of an Author*, 1921 and *Enrico IV*, 1922, and *As You Desire Me*, 1931. To Pirandello, life is necessary self-deception and illusion. Irony, anguish, often lunacy are dramatic consequences.

PIRENNE, HENRI (1862-), Belgian historian, was born at Verviers on Dec. 23, 1862. In his formative years he came under the influence of Godefroid Kurth. After lecturing at the University of Liege he became professor at the University of Ghent in 1886. He was a prolific writer, and devoted his attention to the study of urban and economic life, especially in Belgium. As an independent and collaborating editor he published numerous documents bearing on social and economic history, particularly four stout volumes on the cloth trade of Flanders. His chief work is the *Histoire de Belgique*, the first of its seven volumes appearing in 1900. It received wide recognition, being published in translation in Germany. Before Pirenne, Belgian history had been treated in fragmentary fashion. He perceived and demonstrated the existence of Belgian nationality, a community of Flemings and Walloons drawn together by common traditions and economic interests. During the World War the Germans wished to foster Flemish nationalism and Germanize the University of Ghent; Pirenne refused to collaborate in this, and was deported.

PIRMASENS, a city in the southwestern part of the Bavarian Rhenish Palatinate. It has seven churches and a fine 18th century rathaus. It has considerable industry, chiefly in leather goods and shoes for export trade; musical instruments, machinery and chemicals are also manufactured. Trade in cattle is important commercially. Pop. 1925, 42,946.

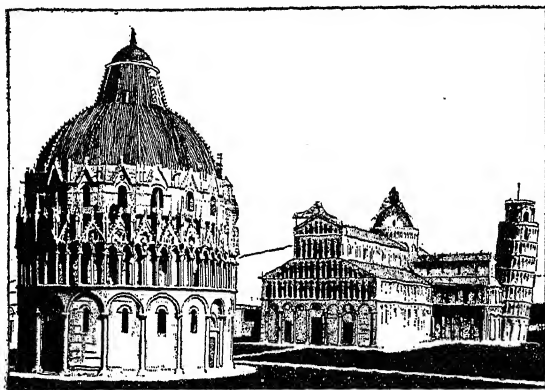
PIRNA, a German city in the province of Saxony, located on the Elbe River about 11 mi. southeast of Dresden. The fortifications have been transformed into pleasant promenades and among the buildings is a fine Gothic church of 1502-46 and an old rathaus; there are also a number of monuments. The chief products are artificial silk, metal and enameled ware, machines and pottery; shipbuilding is also engaged in. Many men are employed in the Elbe sandstone quarries and sandstone and grain are the chief articles of trade; there are excellent shipping facilities. The former Sonnenstein castle, towering over the river, is now a state institution for the insane. Pop. 1925, 31,215.

PIROGUE. See BOAT.

PIROT, a town of Serbia, YUGOSLAVIA, located close to the border of Bulgaria about 50 mi. from Sofia, the Bulgarian capital, with which it is connected by the railway from Belgrade. Pirot, a small

town with an old fortress and other picturesque surroundings, has considerable significance on account of its position. During the Russo-Turkish War in 1877 and 1878 Pirot was taken by the Serbs and incorporated in the Serbian kingdom by the Congress of Berlin in 1878. The Bulgarians captured the town in 1885, keeping it for some time. Again, during the World War, it was overrun by the Bulgarian armies, but was restored to Serbia in 1918. Cloth, woolen braid, carpets and jewelry are made by the people of the town. Pop. 1931, 11,238.

PISA, a city in the northwestern part of Italy, the capital of the province of the same name, situated on the Arno 6 mi. from the sea. A quiet provincial city, it is the seat of an archbishop, and of a university



CATHEDRAL, BAPTISTERY AND LEANING TOWER OF PISA

which dates from the 12th century. The beautiful Piazza del Duomo occupies the northwestern angle of the city and presents one of the most interesting architectural groups of the world. It is bounded on two sides by the pinnacled city wall, and contains the cathedral, the famous Leaning Tower, and the Campo Santo group. The cathedral, a Romanesque basilica, was built 1063-1118 after a great naval victory over the Saracens at Palermo. The baptistery, begun 1153, is, like the cathedral, built entirely of marble. The Leaning Tower was built 1174-1350 by various architects. The Campo Santo, 1278-83, a Gothic wall-enclosed cemetery, is noted for its fine frescoes, sculptures and tombs. There are other churches of interest in the city, as well as beautiful palaces and squares.

In the 11th century, Pisa became the leading seapower in the western Mediterranean; it participated in the Crusades and in conflicts with the Saracens, and was in the 13th century the foremost city in Tuscany. The overthrow of the house of Hohenstaufen marked the end of the city's prestige; the final blow was its defeat by Genoa in 1284. In 1406 internal conflicts resulted in the occupation of this city by the Florentines. On the advent of Charles VIII in 1494 Pisa tried to free herself but was finally deprived of her independence in 1509. The chief industries are wool weaving, printing, and the manufacture of glass, mirrors, porcelain, and ornamental alabaster. Pop. 1931, 73,041.

PISANO or **PISANELLO**, **VITTORE** (1380?-1456?), Italian medallist and painter, was born at St. Vigilio, Italy. He received his training in all likelihood, at Verona, though by some it is asserted that he was a pupil of Andrea del Castagno at Florence. His first important work was the fresco, the story of Otho, for the *Sala del Gran Consiglio*, Venice, which he did with Gentile da Fabriano. His fame as a portrait painter was great, and he soon became the favorite of the great men of his day. He painted Duke Nicholas III of Ferrara, and his portrait of Lionello d' Este, one of his chief patrons, can still be seen in the gallery at Ferrara. He was the painter of the portrait of a princess of the same family which hangs in the *Louvre*, Paris. Pisano was original and one of the most remarkable painters of the 15th century who did not labor under the influence of Mategna. He was a meticulous, painstaking draughtsman, particularly of animals. These display a perfect command of his medium. He is now known chiefly as a medallist, for undoubtedly it was he who gave it its prominence in Renaissance art.



COURTESY M. M. OF ART

MEDAL OF LIONELLO D'ESTE
By Vittore Pisano

PISCES (gen. *Piscium*), the fishes, the twelfth constellation of the Zodiac, is best visible during the early evenings of November and December. It extends over a large area but contains no stars brighter than the fourth magnitude. The alignment of the stars may be most conveniently represented by two strings, one north-south on the east of the square of Pegasus, the other running east-west, and south of Pegasus; the two meeting in the star Alpha Piscium. See *STAR: map*.

PISCICULTURE may be divided into two chief activities, the propagation and rearing of young fish, and the distribution in natural waters of eggs or young fry raised from fish bred in captivity.

Though the first type of pisciculture is old, it is little practiced, for the reason that the species of fish which can be bred and reared in captivity are limited. Only goldfish and the allied species carp have been successfully handled this way. During the Middle Ages, many monasteries had their own fish ponds in order to supply the large amount of fish required in the diet of the monks, but where the fish raised were not carp, as was usually the case, the conditions under which they were raised were nearer natural than artificial. At present, the raising of goldfish for aquariums and the pond culture of carp in China and Germany are the only examples of this type of pisciculture.

Much more is done along the second line of pisciculture, commonly called fish-hatching. Methods of artificial propagation are well understood, and are practiced by special departments of almost all the European countries, and those of the United States and

Canada. Practically every state in the Union has a department or bureau, usually allied with the conservation department, engaged in this work. These various state bureaus work in close cooperation with the U.S. Bureau of Fisheries.

The fertilization of the eggs is easily accomplished. The eggs are secured either by "stripping" ripe females when captured or by keeping the adults alive until ready to spawn and then either stripping them or allowing them to spawn of their own accord. When artificially fertilized, the eggs are placed in a bowl of

million eggs each breeding season. The billions of cod eggs distributed then, really means eggs from but a few thousand females. At any rate, it is impossible to say that there are any more salt-water fish present on the fishing grounds of the Atlantic coast where eggs have been distributed over a number of years. The same plan has been tried in certain fiords of Norway—yet there seem to be as many fish in the unstocked waters as are present in those where millions of eggs and fry have been placed.

In the United States better results have been secured

<i>Species</i>	<i>Eggs</i>	<i>Fry</i>	<i>Fingerlings</i>	<i>Total</i>
Catfish			86,422,900	86,422,900
Buffalofish	35,613,000		1,376,300	36,989,300
Common sucker	6,750,000			6,750,000
Carp	95,375,000	2,600,000	4,388,100	102,363,100
Shad		4,813,000		4,813,000
Glut herring		10,000,000		10,000,000
Whitefish	6,450,000	146,815,000		153,265,000
Cisco		33,950,000		33,950,000
Chinook salmon	2,310,000	1,585,000	20,971,200	24,866,200
Chum salmon	250,000	23,791,000	403,000	24,444,000
Silver salmon	828,000	4,838,000	2,091,000	7,757,000
Sockeye salmon	4,667,000	6,430,000	20,182,300	31,279,300
Humpback salmon	1,021,000	5,227,000	54,400	6,302,400
Steelhead salmon	2,490,000	795,000	4,485,300	7,770,300
Atlantic salmon	755,000		106,400	861,400
Landlocked salmon	35,000	80,000	845,800	960,800
Rainbow trout	5,688,000		7,216,200	12,904,200
Golden trout			10,000	10,000
Black-spotted trout	6,818,000	55,000	9,584,100	16,457,100
Loch Leven trout	10,896,000	2,149,000	2,930,000	15,975,000
Lake trout	415,000	30,093,000	680,500	31,188,500
Brook trout	500,000	2,353,000	14,046,600	16,899,600
Grayling		1,000,000		1,000,000
Smelt	12,000,000			12,000,000
Pike and pickerel			451,000	451,000
Mackerel		16,502,000		16,502,000
Crappie			19,436,400	19,436,400
Largemouth blackbass		1,280,000	1,898,400	3,178,400
Smallmouth blackbass		480,000	52,500	532,500
Rock bass			94,500	94,500
Warmouth bass			34,300	34,300
Sunfish			30,499,000	30,499,000
Pike perch	24,850,000	141,515,000		166,365,000
Yellow perch	53,700,000	117,685,000	2,661,500	174,046,500
White bass			285,500	285,500
Rio Grande perch			5,800	5,800
Fresh-water drum			2,400	2,400
Cod	2,055,034,000	229,769,000		2,284,803,000
Haddock	220,344,000	36,416,000		256,760,000
Pollock		616,713,000		616,713,000
Winter flounder	6,692,000	3,329,897,000		3,336,589,000
Misc. fishes			18,954,900	18,954,900
Total	2,553,481,000	4,766,831,000	250,170,300	7,570,482,300

salt or fresh-water, according to the species involved, to which a little milt from the males is added. The eggs are then distributed in the waters to be stocked or are kept in suitable water tanks, hatched, and the fry raised until they are active and hardy.

Whether or not the placing of the eggs or fry of the more important salt-water species in various fishing grounds has been worth while is still a debated question. While from various reports it may seem that enormous quantities of salt-water fish eggs are distributed annually, these figures do not seem so large when it is remembered that the female of certain species, such as the cod, naturally drops several

in fresh-water and many brooks and ponds, once entirely fished out, now offer good sport to the fisherman as the result of stocking.

The species propagated by the U.S. Bureau of Fisheries include two kinds of catfish, suckers, two carp, two varieties of shad, sixteen kinds of salmon and trout, graylings, pike, ten varieties of sunfish and bass, two kinds of perch, drum, cod, flounders, pollock, hake and mackerel.

During 1930 the Bureau distributed eggs and fry of various species as shown in the accompanying table.

Forty-four states are engaged in fish-cultural activities, maintaining a total of 369 hatcheries, in which

are employed 1,096 people. The total expenditure in these states during 1930 was \$3,624,046.55. In general, these activities are supported with money received from sportsmen for fishing licenses. In this group of states 5,318,104 licenses were issued, bringing a revenue of \$7,314,928.13. The output of fish from these state hatcheries in 1930 was as follows:

Trout	Bass	Other Game Fish	Commercial species
241,786,864	9,173,142	865,030,216	3,468,243,027
Total fish. 4,584,233,249			

Another important activity of the U.S. Bureau of Fisheries is the salvaging of fish from the Mississippi. Every year, millions are stranded in bayous and temporary ponds after the spring floods and die when these waters dry up later in the season. For several years, crews from the Bureau have been netting these fish and either returning them to the main stream or using them to stock rearing ponds in the Upper Mississippi River Wild Life Refuge. In 1930, over 161,000,000 fish were thus salvaged.

As the fishing grounds of the world become overfished and exhausted, the breeding and distribution of food fishes is sure to become more and more necessary. This is recognized in every civilized nation, and every year, more attention is being given to this important and economically valuable work. A. R. F.

PISCIS AUSTRINUS (gen. *Piscis Austrini*), the southern fish, a small constellation containing the brilliant first magnitude star Fomalhaut, and best visible during early evenings in the fall. If the line joining the two western stars of the square of Pegasus is extended southward by three times its own length it passes through Fomalhaut. See **STAR: map**.

PISEMSKI, ALEXIS FEOFILACTOVICH (1820-81), Russian dramatist and novelist, was born in Kostroma, Russia, Mar. 10, 1820. After a short military career, he became a lecturer in mathematics at the university of Moscow. He is chiefly known, however, for the realistic pictures of middle-class life in Russia that abound in his novels and dramas. Though a writer of the old school, he has produced some immortal characterizations. Such, for instance, is the hypocritical hero Kalinovich in the provincial novel called *A Thousand Souls. The Hard Lot*, a drama, has been called one of the best Russian realistic tragedies. Písemski died at Moscow, Jan. 21, 1881.

PISOLITE. See **OÖLITE**.

PISTACHIO (*Pistacia vera*), a small tree of the cashew family extensively cultivated for its edible nuts. It is a native of western Asia, whence it was introduced into southern Europe in ancient Roman times. The tree grows sometimes 30 ft. high, with spreading branches bearing pinnate leaves of many leaflets, brownish green flowers and a drupelike nut containing a pleasantly flavored green flesh. Pistachio nuts, most extensively used in Turkey, Greece and in other parts of southern Europe, are a staple article of commerce. They are dried like almonds and the kernels

trees have been experimentally grown in California.

PISTOIA, a city and episcopal see in the northwestern part of the peninsula of Italy, situated about 20 mi. northwest of Florence. It has ancient walls, a tower and citadel, a cathedral restored in the 13th century, containing important works of art, also other churches of the 14th and 16th centuries, and imposing palaces. Manufactures include machinery, iron, railroad cars, glass, phonograph records and silk. Pistoia was taken by Florence and Lucca in 1306, and remained afterwards under the rule of the Florentines. Pop. 1931, 70,397.

PISTOL, a short-barreled weapon fired from the hand. The United States standard military pistol is a .45 caliber automatic type, known generally as the Colt pistol, using a magazine in its stock holding six cartridges. See **AUTOMATIC PISTOL**.

PISTOLE, formerly a name used in France for the Spanish double escudo, a gold coin which came into use in the 16th century, equivalent to about \$4.00; also applied to other European coins of similar value.

PITAKAS, *Tipataka*, or "Three Baskets," the Canon or Bible of Buddhist sacred scriptures, composed originally in the Pali language, and done also in Sanskrit. The "three baskets" of tradition are: (1) *Sutta-pitaka*, or basket of sermon materials, (2) *Vinaya-pitaka*, or body of rules of discipline, and (3) *Abhidhamma-pitaka*, or materials bearing upon the study of Buddhist theory as such (might be called "the higher *dhamma*, or 'religion'"). The *Tipatakas* were brought together into a Canon within 3 centuries after Buddha's death in 480 B.C., and represent earlier or "Hinayana" **BUDDHISM** in contrast with the later "Mahayana" which added many writings but has no official Canon. Many of these sources are available in sound English translations.

PITCAIRN, HAROLD (1897-), American aviator and airplane manufacturer, was born at Bryn Athyn, Pa., June 22, 1897. He studied one year at the University of Pennsylvania and entered the U.S. Army Air Corps during the World War. Pitcairn established and became president of Pitcairn Aviation, Inc., of Philadelphia, Pa., which operates flying-fields in several States, and was also made director in the National Air Transport, Inc. In 1928 he purchased the American rights for the **AUTOGIRO** of **JUAN DE LA CIERVA** and his success in developing it earned him in 1931 the Collier Trophy, awarded by the National Aeronautic Association.

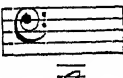
PITCAIRN, a borough in Allegheny Co., southwestern Pennsylvania, situated 15 mi. southeast of Pittsburgh. The Pennsylvania Railroad affords transportation. Pitcairn is surrounded by farms. The industries include railroad shop and freight yard work and coal-mining. Natural gas wells are found in the vicinity. Pitcairn was incorporated in 1894. Pop. 1920, 5,738; 1930, 6,317.

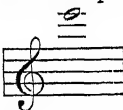
PITCH, the more or less viscous, or solid, black residuum from the distillation of **TAR** or asphaltic **PETROLEUM**. It is composed of a variety of hydro-

point from 35 to 100° C. according to the maximum distillation temperature. It is widely used for built-up roofings, pipe coverings, street paving, road tars, protective coatings, joint cement, fuel-briquet binders, and in insulating compounds. Hard pitch is used as a core binder in making castings and in the manufacture of carbon electrodes and clay pigeons. Surplus pitch is converted by further heating into pitch coke, which has a very low ash and sulphur content. *See also* WOOD DISTILLATION. A. C. F.


PITCH, in music, the position of a tone in a scale of vibration frequencies, being higher when the vibrations are more rapid and lower when the vibrations are slower. In the former case the tone is termed acute; in the latter, grave. The relative acuity or gravity of a tone may be directly indicated by musical NOTATION, but its actual pitch can be stated only in terms of vibration frequency, or else in terms of the length, mass and tension of the vibrating body. Both ABSOLUTE PITCH and CONCERT PITCH are defined in terms of vibration. Since all air-waves travel with the same velocity which is the constant one of 1170 feet per second (at a temperature of 68° Fahrenheit, increasing about 2 feet per second for each additional degree), it is theoretically possible to define pitch also in terms of the length of an air wave. However, as it is exceedingly difficult to measure an air wave directly, and on the other hand simple to count pulsations (for example, by means of a graph produced by a tuning-fork or by a siren which has an ascertained number of vents and is revolved at a certain known speed), measurement of the frequency is the common method and the preferred one.

Regarding the range of audibility, ears vary; but a tone produced by less than 16 vibrations per second,

that is, two octaves below , or by more than 5,000 vibrations per second, that is, about two

octaves above , may be said to have passed

out of the realm of music, even though Appun and Preyer's tuning-fork produced 40,960 vibrations per

second, that is, five octaves above .

Though an acute tone travels no faster than a grave tone, when the auditor is moving toward a set of air-waves, traveling through them in an opposite direction, he hears a *higher* tone than he would hear if he remained stationary. Contrariwise, when the auditor travels in the *same* direction as the air-waves, he hears a tone which is *lower* than the normal one. But this apparent paradox, known as the Döpler Effect, is a paradox in name only, inasmuch as two or more tones of different pitches would simultaneously vary under the circumstances mentioned. The change of pitch indicates simply that the normal frequency is

altered by crowding the air-waves closer together, on the one hand, or by spreading them out over a greater area, on the other. W. P.

PITCHBLENDE, a massive and probably amorphous form of URANINITE which serves as an ORE of uranium and of radium salts. It has a pitch-like appearance, and is usually grayish, greenish, brownish, or black in color. The composition is not definite, but it contains radium, lead, calcium and water, in addition to uranium, and also some nitrogen, helium, and argon. It is found in sulphide veins with ores of silver, lead, nickel and copper, as in the deposits of Bohemia and in small amounts in Colorado, and in unimportant pegmatite dikes, in the Appalachians.

Radium is used in various medical treatments, as for cancer, and in luminous paints. Uranium is used as a source of radium, and its salts for coloring glass yellow. *See* CARNOTITE; SAMARSKITE; ORE DEPOSITS.

PITCHER, MOLLY (1751-1800), a legendary American heroine, identified with Mrs. Margaret Corbin, was born in Franklin Co., Pa., Nov. 12, 1751. In 1772 she married John Corbin, and when he joined the artillery division of the Revolutionary army, she followed him. In the Battle of Ft. Washington, Nov. 16, 1776, she saw her husband killed while firing a cannon, took his place in the battleline, and fought until severely wounded. When Ft. Washington surrendered she was not taken prisoner but allowed to go to Philadelphia. Later she was given a soldier's pension. She died in Westchester Co., N.Y., Jan. 16, 1800.

PITCHER PLANTS, the name applied to plants with leaves which are pitcher-like in form or bear pitcher-like structures. The plants most widely known by this name are the numerous species of *Nepenthes*. These have pitcher-like structures at the end of tendril-like elongations of the leaves. In the Australian pitcher plant (*Cephalorus follicularis*) the lower leaves form pitchers while the upper ones are flat and green. In the North American pitcher plants (*Sarracenia* sp.; *Darlingtonia*) all the leaves are developed into pitcher-like structures. The pitchers, which are usually highly colored, very widely in size, some having a capacity of about a quart. Insects, attracted by various sweet secretions, enter the pitchers and are drowned in the watery liquid at the bottom. Their bodies are dissolved by digestive juices or by bacterial decomposition and utilized to some extent by the plant as food. *See* CARNIVOROUS PLANTS; CALIFORNIA PITCHER PLANT; INSECTIVOROUS PLANTS; NEPENTHES; SARRACENIA.

PITCHSTONE, a variety of volcanic glass which usually corresponds to TRACHYTE or RHYOLITE in composition. It is a form of OBSIDIAN in which the appearance of the surface is resinous instead of glassy, so the rock appears duller. While the obsidians are usually black or red, pitchstones are often red or green. The water content of pitchstones is higher than obsidian, running from five to ten per cent. Silver Cliff, Colorado, has provided some fine specimens of pitchstone. *See also* PETROLOGY.

PITMAN, SIR ISAAC (1813-97), English educator, was born at Trowbridge, Jan. 4, 1813. After studying at a London normal school he became in 1832 master of a school in Lincolnshire. His first principles of shorthand writing were published in 1837 in his *Stenographic Soundhand*. In the succeeding years he gradually perfected the Pitman shorthand system which superseded previous systems and became widely used in England and the United States. Pitman published manuals for its instruction in schools and in 1842 founded the *Phonetic Journal*. The next year he organized the Phonetic Society. About 1840 the British Government offered a prize of £200 for the best method of collecting the postage on prepaid letters, and Pitman won this contest with his idea of postage stamps. He died at Bath, Jan. 22, 1897.

PITMAN, a borough of Gloucester Co., N.J., situated 15 mi. south of Philadelphia, Pa. It is served by the Pennsylvania and West Jersey and Seashore railroads, and motor bus lines. It is strictly a residential community and summer resort, having a summer population estimated at approximately 15,000. Pop. 1920, 3,385; 1930, 5,411.

PITOT TUBE, an instrument for measuring the velocity of flow of fluids in pipes and unconfined streams where the velocity is fairly high. In its simplest form, the pitot velocity meter consists of a

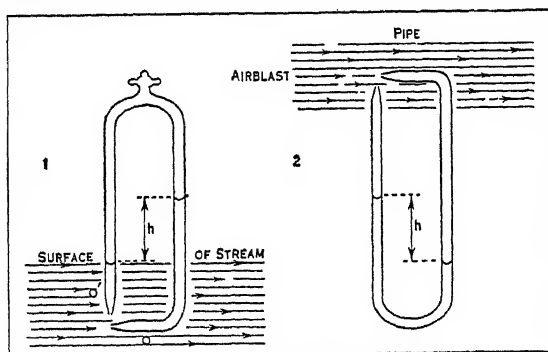


FIG. 1. SIMPLE FORM OF PITOT VELOCITY METER

FIG. 2. PITOT TUBE USED FOR MEASUREMENT OF AIR VELOCITY

bent glass tube of the form shown in Fig. 1. If the small orifice, O , is faced up stream, the water in the tube is equivalent to a pressure, P , at O . If P' represents the pressure at O' , BERNOULLI'S THEOREM may be applied to give the equation, $P' + \frac{1}{2} dV^2 = P$, where V is the velocity of the stream. From this is de-

rived $P - P' = \frac{1}{2} dV^2$, or $V = \sqrt{\frac{2h}{d}}$ when $h = P - P'$.

In practice, the tube should be calibrated, and will be found to take the form $V = k \sqrt{\frac{2h}{d}}$, k being very close to unity. Absolute c.g.s. units should be used, that is, h should be expressed in DYNES and d in grams per cu. cm. If a is the area of the pipe or the stream, the quantity of the fluid passing a given point in unit time is av .

The form of the tube shown in Fig. 2 may be used to measure the velocity of the air in WIND TUN-

NELS and the flow of gases in pipes. It may also be used to measure the velocity of the wind by attaching a vane to the tube to keep it pointing in the proper direction.

E. J. M.

PITT, WILLIAM, EARL OF CHATHAM (1708-78), English statesman, called the Elder Pitt, was born at Westminster, Nov. 15, 1708, son of Robert Pitt, of Cornwall, and grandson of Thomas Pitt, an East Indian merchant and governor of Madras. He was educated at Eton and at Trinity College, Oxford. Ill health caused him to leave college and travel on the Continent. Returning to England he entered the army in 1731. Four years later he began his Parliamentary career in the House of Commons.

Pitt sided with the party in opposition to SIR ROBERT WALPOLE and proved to be a brilliant orator. Following Walpole's fall in 1742, he was not included in Henry Pelham's ministry, and remained an active member of the Opposition. He bitterly attacked Lord Carteret for his policy favorable to the interests of the House of Hanover. Pitt thus incurred the severe displeasure of George II. In 1746, however, so much pressure was being brought to bear on the king that he reluctantly appointed him vice-treasurer of Ireland and, a few months later, paymaster of the army.

After Pelham's death and the resignation of the Duke of Newcastle as prime minister, the Great Commoner, as Pitt was called, undertook the duties of premier, serving from Dec. 1756 until Apr. 1757. Then for 11 weeks the post was vacant. A coalition was finally formed between Pitt and Newcastle, and the former resumed office.

Embroided in the SEVEN YEARS' WAR, England was fighting for her life against Austria, France, Russia and Sweden. "I am sure I can save this country, and nobody else can," declared Pitt, and as proof of this statement England rose under his leadership to become one of the greatest nations of the western world. The European allies were defeated and English trade was carried into new colonies.

George III succeeding to the throne brought a change, and dissension in the cabinet caused Pitt to resign in 1761. During the following four years the former premier took less active part in public affairs, and at one time refused the Duke of Cumberland's request to resume office. The statesman attacked the STAMP ACT and declared himself for its absolute repeal. In 1766 the existing ministry fell and Pitt formed a new one, becoming Lord Privy Seal. In the same year he lost considerable popularity by accepting a peerage. Ill health caused him to retire from public life, but in 1770 he resumed his political activities.

Seven years later Pitt declared that "you cannot conquer the Americans" and sought to bring about an end to hostilities between England and America. In 1774 he had urged greater gentleness in dealing with America and in the following year had asked for the recall of troops. In 1778, Pitt rising to the defence of the Colonies, had a seizure in the House of Lords, and, after several weeks' illness, died at Hayes, Kent, May 11, 1778. He was buried in Westminster Abbey.

Ambitious, haughty, a man not always above intrigue, Pitt was nevertheless a man of great "moral enthusiasm," honest and courageous. In the words of Frederick the Great, the Great Commoner was "a lofty spirit, a mind capable of vast designs, of steadfastness in carrying them into execution, and of inflexible fidelity to his own opinions, because he believed them to be for the good of his country which he loved."

PITT, WILLIAM (1759-1806), English statesman, called the Younger Pitt, was born at Hayes, Kent, May 28, 1759, the second son of WILLIAM PITT, EARL OF CHATHAM. He was educated at home and at Pembroke College, Cambridge. In 1780 he was admitted to the bar, and in the next year took his seat in Parliament, where he soon became known as an accomplished speaker. Pitt allied himself with Lord Shelburne, who opposed Lord North. When Shelburne led the ministry in 1782, he appointed his young adherent chancellor of the exchequer. The Shelburne ministry was forced to resign, however, the next year. Pitt then joined the Opposition and sought Parliamentary reform. He failed, but, upon the fall of North and Fox, became prime minister, at the age of 24.

For several months the young premier fought the Opposition party and finally emerged victorious, having won the people's confidence. One of his first acts was to reorganize the nation's finances. His grasp of the problems of taxation and of the budget soon established his reputation as a remarkably able financier. Among his many notable acts was the execution of a new constitution for the East India Company in 1784. He was not always successful, however, failing in the following year to put through legislation for the reform of Parliament.

With the outbreak of the French revolution in 1789, Pitt resolved not to embroil England in European affairs. A series of circumstances, not the least of which was the execution of the French king, Louis XVI, nevertheless brought England into war with France in 1793. Pitt's difficulties increased during the next eight years. The straitened condition of national finances, the unsatisfactory course of the war, and the Irish rebellion added to the prime minister's unpopularity. In 1801 Pitt resigned and was succeeded by Henry Addington, from whom Pitt later withdrew his support. Addington's ministry fell in 1804 and Pitt, again prime minister, formed a third coalition of the powers against France. His health always poor, he could not survive the crushing blow dealt the coalition by Napoleon's victory at Austerlitz. He died at Putney, Jan. 23, 1806, and was buried in Westminster Abbey.

The Younger Pitt was an able financier, an excellent administrator and a man of unimpeachable integrity. As a war minister he has been unfavorably compared with his father, the Earl of Chatham, but, as historians point out, the Elder Pitt had Frederick the Great as his ally; the Younger Pitt had Napoleon as his adversary.

PITTI PALACE, an imposing Renaissance edifice of Florence and one of the largest palaces in Italy, the site of the celebrated Pitti Gallery which contains

over 500 paintings by the greatest Italian masters. Its façade of massive blocks of stone, broken by Renaissance windows, is the outstanding sight of the Boboli Hill of the left bank of the Arno River. The structure is three stories high and was designed in 1440 by Brunelleschi for Luca Pitti, an opponent of the Medici family. It was not until 1852, having passed through several owners, that all of the building was completed. The palace is now the residence of the king of Italy when in Florence. In the gallery hang paintings by Fra Filippo Lippi, Perugino, Fra Bartolomeo, Andrea del Sarto and a number by Raphael. The Venetian School is represented by Giorgione, Sebastiano del Piombo, Titian, Tintoretto and Veronese. There are also works by Van Dyck, Rembrandt, Velazquez and Rubens.

PITTOSPORUM, a numerous genus of evergreen trees and shrubs of the pittosporum family, many of which are grown in warm countries as ornamentals. These are about 100 species, native to the tropics of the Old World, chiefly in the Southern Hemisphere. They bear somewhat leathery, usually entire leaves and numerous, often fragrant flowers, mostly in terminal clusters. Various species are planted in southern California as hedge plants and as other ornamentals. Among these are the cape pittosporum (*P. viridiflorum*), the Queens-land pittosporum (*P. rhombifolium*), the karo (*P. crassifolium*), the tarata (*P. eugenioides*) and the Victorian-box (*P. undulatum*).

PITTSBURG, a port and industrial city in Contra Costa Co., western California, on New York Slough, an inlet of San Francisco Bay. It is served by ocean-going steamers and three railroads. Truck farming is carried on in the vicinity. Pittsburg has fishing industries and fisheries. There are fruit, asparagus, and salmon canneries, lumber and steel mills, and factories producing fire brick and chemical, asbestos and lumber products. The site was settled in 1835. Pittsburg was incorporated in 1903. About 10 mi. south is Mt. Diablo State Park. Pop. 1920, 4,715; 1930, 9,610.

PITTSBURG, a city in Crawford Co., southeastern Kansas, situated 130 mi. south of Kansas City. Bus lines and four railroads make the city a shipping center. There is an airport. Pittsburg lies in an important bituminous coal field. Lead, gas, zinc and oil are found near by. Grain and live stock are raised in the vicinity. The city has railroad shops, iron foundries and various manufactures. In 1929 the factory output amounted to approximately \$5,000,000; the retail trade was valued at \$12,623,320. Kansas State Teachers' College of Pittsburg, with a student body of more than 5,000, was established in 1903. Crawford County State Park and Game Refuge is three mi. north. Pittsburg was founded in 1879 and chartered in 1880. The population increased very rapidly between 1880 and 1890. Pop. 1920, 18,052; 1930, 18,145.

PITTSBURGH, the 2nd city and a port of entry of Pennsylvania, 10th largest in the United States, situated in the southwestern part of the state, at the union of the Ohio with the Allegheny and Mononga-

hela rivers with the Ohio River, at 40° 36' N. lat. and 80° 2' W. long. Pittsburgh is the seat of Allegheny Co. and the metropolis of the Ohio Valley. The city is 260 mi. directly northwest of Philadelphia. It covers an area of 54.5 sq. mi., and its population in 1920 was 588,343; in 1930, 669,817, representing an increase of 13.8% in ten years. A large foreign population is absorbed by the great mills of the Pittsburgh district, leading center of the iron and steel industry of the United States. In January the average temperature at Pittsburgh is 30.7° F., in July 72.3° F. The average annual precipitation is 36.17 in.

Geographic Setting. The original site of Pittsburgh is the land between the angle formed by the Allegheny flowing from the northeast, and the Monongahela, flowing from the east and south. The two rivers join to form the Ohio, opposite "The Point," where the French settlers built Ft. Duquesne. Pittsburgh was situated at a natural meeting place for railroads and river boats; it was the best place on the plateau for bringing together coal and iron ore, an advantageous factor which gave it an early start in the smelting and manufacture of iron. After the Superior iron mines were opened and many of the Pennsylvania mines closed, Pittsburgh continued to be a smelting town because of the coal and limestone supply close at hand iron ore came to the coal and limestone. The modern city of Pittsburgh is composed of three sections, built north and northwest of the Allegheny, east and south on the tongue enclosed by the two rivers, and south and west along the left bank of the Monongahela. The valleys of the three streams are flanked by bluffs leading to uneven plateaus, rising to between 400 and 500 ft. above sea level. The hilly character of the site, combined with the winding courses of the Allegheny and Monongahela, created difficulties in the work of street-planning, unknown to cities built on level ground. In the main the streets in the three sections do not follow the direct points of the compass, but are laid out parallel or at right angles to the adjacent bank of the river flowing past each respective section. The business district of Pittsburgh is in the area immediately east of The Point, between the two tributary rivers. In this narrow section, dotted with skyscrapers, the numbered avenues extend parallel to the Monongahela. Fifth Avenue is the foremost retail street, and Fourth Avenue the banking artery. In this older section the principal buildings are the Allegheny Courthouse, a structure occupying two blocks on Grant Street, with a small bridge crossing Ross Street; the Frick office building of white granite, containing a stained glass window in the main hall by John LaFarge; and the Federal Building of polished granite. Noteworthy churches include St. Paul's Cathedral of Indiana limestone in Gothic style at Fifth Avenue and Craig Street and Calvary Protestant Episcopal Church on Shady Avenue. The Mellon Institute of Industrial Research is located here.

The finer residential district lies in the eastern

part of the river tongue, between the Ohio's tributaries and along the banks of the latter streams. The park system covers about 1,500 acres. Schenly Park overlooks the Monongahela from the north and east, and Highland Park is on the southern bank of the Allegheny. The factories and extensive steel mills are chiefly located along the banks of the three rivers, on the outskirts of Pittsburgh.

Transportation and Industry. Pittsburgh is served by 14 railroads, including the Pennsylvania and the Baltimore and Ohio. The city has more than 100 bridges and viaducts, exclusive of railroad trestles. The twin Liberty tubes connect the district south of the Monongahela with the business section. The Monongahela is navigable 128 mi. east and south of Pittsburgh its entire length; and the Allegheny is navigable 61 mi. to the upper counties of western Pennsylvania. As a consequence Pittsburgh, with a river front of 54 mi., has extraordinary water facilities, and there is an extensive barge and steamer traffic with Mississippi cities reached by way of the Ohio. River traffic in 1930 amounted to 30,612,883 tons, valued at \$187,466,962. In 1928 the sum of \$1,500,000 was set aside for the Municipal Airport. Street railways provide transportation within the city.

Pittsburgh owes its importance in part to its location in the approximate geographic center of an area rich in coal, petroleum and natural gas. Leading manufactures in 1929 were iron and steel products, foundry and machine shop products, printed matter and publications, meat products, and glass and aluminum. In 1929 manufactures were valued approximately at \$545,000,000; the retail trade amounted to \$454,213,529; the wholesale trade proper, to \$514,511,525. In 1930 Pittsburgh, with the rest of Allegheny Co., had a wholesale trade, all establishments, valued at approximately \$1,562,495,436. In the Pittsburgh district are the plants of the United States Steel Corporation, Carnegie Steel Co. and the Westinghouse Electric Co.

Educational Institutions. Foremost educational institutions in Pittsburgh are the Carnegie Institute of Technology, University of Pittsburgh, Duquesne University, Pennsylvania College for Women and Western Theological Seminary.

History. The site of Pittsburgh was visited by La Salle and other early French explorers in the late 17th century. In 1754 a force of Virginians built a fort on The Point as a warning to the French. The colonial forces were defeated by the French in 1755, but the British recovered the territory three years later. At Washington's suggestion, the site was named Pittsburgh, in honor of William Pitt. The town was laid out in 1754, in 1794 incorporated as a borough, and in 1816 obtained its city charter.

PITTSBURGH, UNIVERSITY OF, a non-sectarian institution for men and women at Pittsburgh, Pa. It is the oldest existing educational institution west of the Alleghenies. Chartered in 1787 as Pittsburgh Academy, it was reincorporated in 1819 as Western University of Pennsylvania. It received its

present title in 1908. In 1926 was begun the unique skyscraper Cathedral of Learning, occupying a 14-acre quadrangle and planned to house all the undergraduate schools of the university except those of Medicine and Dentistry. The Thaw Refractor, a photographic refractor of 30-inch aperture in the Allegheny Observatory, is of great value in astrological research. The institution had productive funds in 1931 totaling \$2,023,555. The main library contained 144,703 volumes. In 1930 there were 16,259 students and a faculty of 985, headed by Chancellor JOHN G. BOWMAN.

PITTSBURGH LANDING, BATTLE OF. See SHILOH, OR PITTSBURG LANDING, BATTLE OF.

PITTSFIELD, a city and the county seat of Berkshire county, western Massachusetts, 58 miles northwest of Springfield. It is served by the Boston & Albany and New York, New Haven & Hartford railroads. Situated in the Berkshire hills on the Housatonic River and several lakes, it is a popular summer and winter resort. The principal manufactures are electrical machinery, textiles and fine stationery. The manufacturing production for 1929 totaled \$60,864,736; retail business, \$32,057,399. Pittsfield was founded in 1743 and incorporated as a city in 1891. Pop. 1920, 41,763; 1930, 49,677.

PITTSTON, a city of Luzerne Co., northeastern Pennsylvania, situated on the Susquehanna River, half way between Scranton and Wilkes-Barre, about 10 mi. from both. Pittston is a railroad center served by six roads. The leading interest of this region is anthracite coal-mining. Large deposits of fire clay are found in the vicinity. The chief local manufactures include paper, silk, knitted goods and terra cotta. In 1929 local manufactures amounted approximately to \$2,000,000; the retail trade reached a total of \$9,611,358. The Susquehanna Company of Connecticut founded Pittston about 1768, naming it for the elder Pitt. The first permanent settlers came in 1770; the borough was incorporated in 1803 and became a city in 1894. Pop. 1920, 18,497; 1930, 18,246.

PITUITARY GLAND, or **HYPOPHYSIS**, a gland of internal secretion situated approximately in the center of the base of the brain cavity in a rounded depression in the sphenoid bone (see SKULL). It consists anatomically, developmentally, and functionally of two portions, an anterior and an intermediate-posterior. The anterior lobe develops from a pouch growing upward from the roof of the mouth in the embryo, and the remaining portion develops as another pouch from the floor of the embryonic brain-tube. The anterior lobe is crescent-shaped and partially surrounds the posterior lobe. Microscopically the two portions differ fundamentally. The anterior lobe is composed of three types of cells which react differently to stains. The remainder is composed of two divisions: the intermediate and posterior lobes. The intermediate lobe is constituted of glandular appearing cells which do not take a stain with avidity. The posterior lobe does not resemble a gland at all, but is filled with the mossy neuroglia cells that hold together the components of the brain.

Experiments on the *anterior lobe* indicate that it profoundly influences the growth of the skeleton. It may have a specific relationship to the growth of hair. If it undergoes hypertrophy before puberty, a condition of gigantism develops. If this occurs after puberty **ACROMEGALY** is the result. Gigantism is simple and proportionate overgrowth of the bones. After puberty the separate portions of the shaft have united and the long bones are capable of no further growth in length. The only growth possible is one of thickening. Thus large, thick hands and feet result and the jaw becomes heavy. If the anterior lobe atrophies, less than normal of its hormone is produced. As a result, the skeleton is underdeveloped, but the proportions remain normal. This is infantilism of the Lorain type.

The *posterior lobe* has been convicted of a wide variety of functions, but those that have stood all tests are the production of a rise in arterial blood pressure (pressor effect) and a contraction of the smooth muscle of the uterus (oxytocic effect). The latter function is so marked that commercial extract of the posterior lobe of animals is injected into women during parturition to assist the contraction of the uterus. This extract is called pituitrin.

In the past, *removal of the pituitary* was thought to produce a greatly increased flow of urine, to cause sugar to be excreted by the kidney, and to induce a condition characterized by a marked storage of fat together with diminution in size of the genitalia. This has since been shown to be due to injury of the hypothalamic region of the brain, where centers for the regulation of the vital activities are localized.

Tumors of the pituitary readily overgrow the small pouch in which the pituitary is located and produce pressure on the surrounding brain. Injury of the optic nerve produces partial blindness, and pressure on the hypothalamus induces the symptoms just referred to. W. J. S. K.

PITYRIASIS VERSICOLOR, an infection of the skin by a vegetable parasite known as the *Microsporon furfur*. It causes a yellowish or brownish flat eruption on the chest and shoulders. Sometimes the abdomen and armpits are involved, but rarely the face. The patches of eruption are covered with bran-like scales. There may be slight itching, but there are no other symptoms.

The disorder is harmless and responds readily to treatment. The frequent use of soap and water, followed each time by liberal application of a solution of sodium hyposulphite often proves curative.

PIUS, name of 11 popes. St. Pius I, 140-155, was the brother of the pastoral writer Hermes. Pius II, 1458-64, Aneas Sylvius, a brilliant scholar, writer, scientist and diplomat, was at one time secretary to Emperor Frederick III, whom he later opposed for the purpose of strengthening the papacy. His other chief object was to organize a crusade against the Turks but his plan, left without support by the monarchs of Europe, was a failure. Pius III, nephew of Pius II, succeeded Alexander VI on Sept. 22, 1503,

but died Oct. 18. Pius IV was Pope from 1559 to 1565. The most important act of his reign was the reconvening of the Council of Trent in 1562. St. Pius V, 1566-72, previously grand inquisitor, was a stern reformer of the church, disciplinarian and reviser of the liturgy. He opposed Protestants with all his power, excommunicated Elizabeth of England and confirmed the rights of Mary Stuart to the crown. Pius VI, 1775-99, was an able administrator who furthered public works in the Papal State. The French Revolutionists, however, despite enormous concessions made to Bonaparte, robbed him of his secular power and he was kept under military guard in various Italian cities until his decease. Pius VII, 1800-23, reorganized the Papal State and was present at Napoleon's coronation, but French troops reoccupied Rome and Napoleon took from him his temporal power. For refusing to accept Napoleon's conditions, Pius was taken to Fontainebleau, and refused the annuity the Emperor offered him. He later made a concession, which he withdrew, and in 1814 returned to Rome where he ably reorganized the papal hierarchy. The Treaty of Vienna restored his Italian possessions and he ruled the Papal State mildly, improved its administration, did much for charity and supported the arts and sciences. Pius VIII, 1829-30, granted his subjects material relief, but his policy was opposed to liberal thought. Pius IX, 1846-78, was the first "Prisoner of the Vatican," who, during his long, dramatic reign, though shorn of temporal power increased enormously the influence of the papacy. (See Pius IX.) Pius X, 1903-14, could not prevent the separation of Church and State in France, though he accomplished much in the inner administration of the Church. (See also Pius X.) For Pius XI, the present eminent pontiff, see article Pius XI.

See for Pius VII and Pius IX, W. Barry, *Papacy and Modern Times*, 1803-70, 1911.

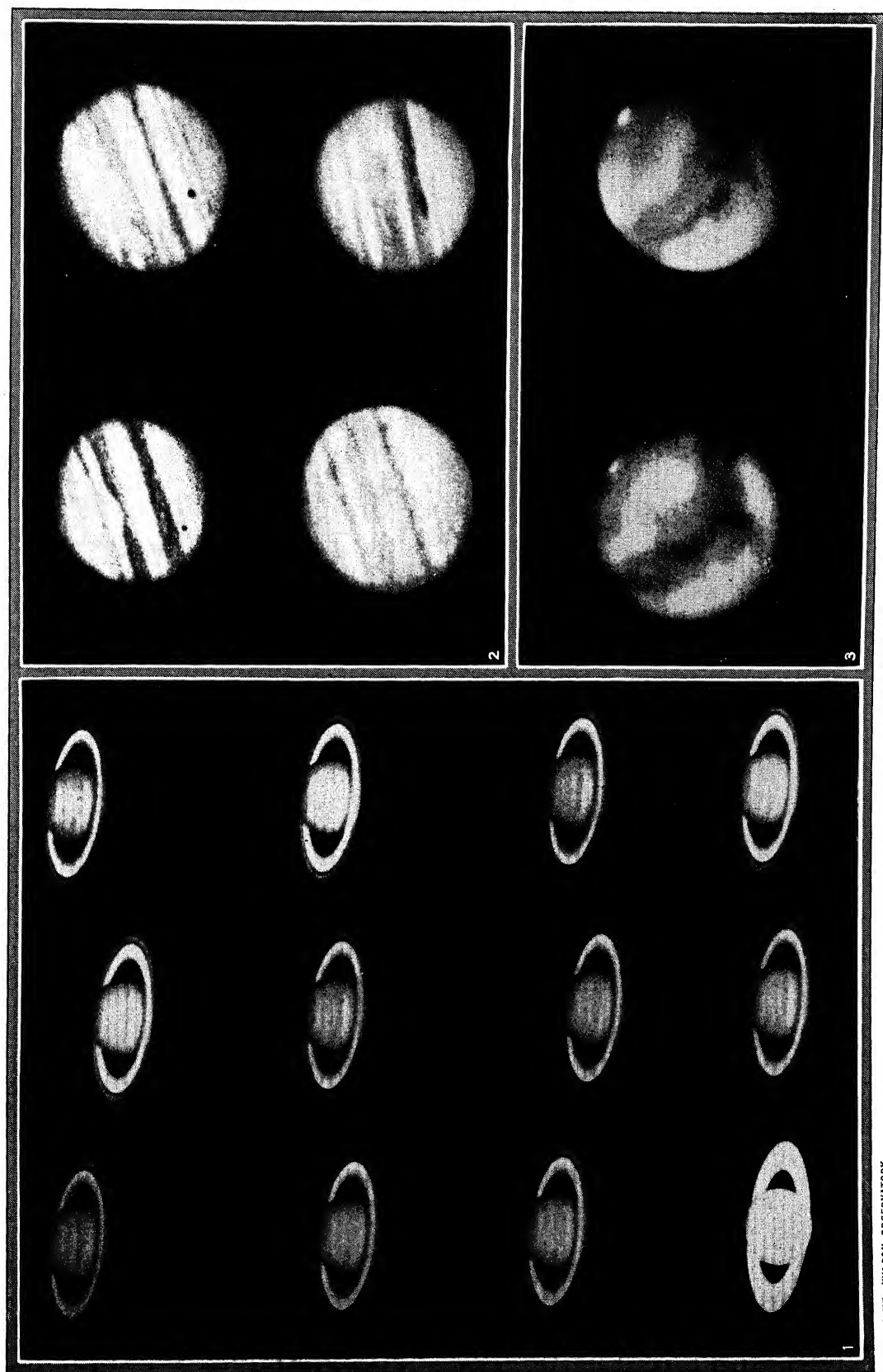
PIUS IX, Pope, 1846-78, previously Giovanni Maria, Count of Mastai-Feretti, born May 13, 1792, at Sinigaglia. He was a missionary in Chile in 1823, archbishop of Spolete in 1827, bishop of Imola in 1833 and cardinal in 1840. Due to his promise of political reform, he was joyfully greeted in Rome, submitted at first to the Revolution of 1848 and agreed to the Constitution of March, 1848, but fled Nov. 24 to Gaeta. He returned after Rome had been occupied by French troops, Apr. 12, 1850, and became reactionary in his methods. He lost the Romagna in 1859 and the Marches in 1860 and, due to the French protection, retained only the Patrimony of St. Peter. He gave up all liberal ideas, and on Dec. 8, 1854, promulgated the dogma of the Immaculate Conception of the Blessed Virgin and issued the Syllabus *Quanta cura* against errors in modern thought. On Dec. 8, 1869, he summoned an ecumenical council at the Vatican, which made the infallibility of the pope a dogma. He lost Rome, July 18, 1870, and refused the guarantee offered by the Italian Government. Thus he became voluntarily the first "Prisoner of the Vatican."

PIUS X, Pope, 1903-14, born June 2, 1835, at Riese. He became canon in Treviso in 1875, bishop of Mantua in 1884 and cardinal and patriarch of Venice in 1893. He granted his subjects the right to participate in the elections and invalidated the Concordat of 1801 with France, whereupon the French Government broke off diplomatic relations with the Vatican. In 1905 he protested against the separation of State and Church in France. He insisted upon inner reforms in the Church and in 1906 gave a new impetus to Biblical studies. In his syllabus of 1907, the encyclical *Pascendi dominici gregis*, he opposed "modernism" most vigorously. In 1910 he issued the *Banormus* encyclical and the next year began the reform of the Breviary. He furthered missionary activity by rearranging mission territories.

PIUS XI, Pope since Feb. 6, 1922, previously Achille Ratti, born May 31, 1857, in Desio near Monza, Italy. He was ordained priest in 1879, became professor at the Theological Seminary at Milan in 1882, in 1888 Librarian of the Ambrosiana there, in 1907 prefect of the same library, in 1914 prefect of the Vatican Library, in 1919 nuncio in Warsaw, Poland, and titular archbishop of Lepanto, and in 1921 archbishop of Milan and cardinal. The most important acts of his pontificate thus far have been. the concordats with Latvia, Bavaria, Poland and Lithuania; the reorganization of the Society of the Propagation of the Faith and the centralization of the domestic missionary societies, the carrying out of the Catholic Action, the refusal to join in the attempts of other religious bodies to attain Christian unity; the establishment of the Feast of Christ the King; his adverse judgment against the monarchistic organization "action française" and his participation in the Mexican controversy between Church and State. His greatest achievement, however, was the Treaty of the Lateran, 1929, in which the pope's temporal sovereignty was recognized in regard to the Vatican City. Besides the widely discussed encyclical on Christian marriage, the pontiff startled the world with his encyclical on reconstructing the social order. He has spoken over the radio in world-wide broadcast.

PIZARRO, FRANCISCO (c. 1471-1541), a Spanish soldier and the conqueror of Peru, was born at Truxillo in Estremadura, Spain, about 1471, the natural son of a Spanish soldier. He went to America in 1509 and in 1513 was with Balboa when he discovered the Pacific. Led on by stories of a fabulously rich empire to the south, Pizarro left Panama in 1524 and sailed south to about 7° north latitude but was forced by hardship to return. Again in 1526-27, enduring terrific suffering, Pizarro and a small group reached Tumbez and other Inca towns. In Jan. 1531 Pizarro set out from Panama with permission from Spain to conquer and govern Peru. On Nov. 15, 1532 he met a large Inca army at Caxamarca. The Inca ATAHUALPA was treacherously seized, and though he collected his ransom of a room filled with gold (approximately \$4,500,000) he was killed Aug. 29, 1533. On Nov. 15, 1533 Pizarro entered Cuzco, the

PLANET



COURTESY MT. WILSON OBSERVATORY

THE PLANETS SATURN, JUPITER AND MARS

1. Twelve exposures of Saturn showing two of its three rings. 2. Jupiter, largest planet of the solar system, with a diameter eleven times that of the earth, shown with Ganymede, the third of its nine satellites. 3. Mars, the planet revolving outside the earth's orbit.

Inca capital, and in Jan. 1535 founded the city of Lima as the seat of Spanish Government. The Indians rose under Manco, the legitimate heir to the Inca throne, in Apr. 1536, and for a time Spanish occupation was seriously threatened. Pizarro was killed at Lima by followers of ALMAGRO June 26, 1541.

PLACE, FRANCIS (1771-1854), English reformer, was born Nov. 3, 1771. As a poor tailor, he attempted to better conditions in his trade. As a member of the London Corresponding Society and various trade clubs he was active in most of the reform movements of that period. He established his own tailoring business, amassed a small fortune and then educated himself in social economics. He began in 1814 a successful campaign for the repeal of the Combinations Act which prohibited working men's unions. An astute politician, he was instrumental in securing many parliamentary reforms. His slogan, "To Stop the Duke, Go for Gold" lost Wellington his office. Place died in 1854. He published numerous pamphlets and articles.

PLACENTA, or AFTER-BIRTH, a complex structure which develops at the same time as the fetus in the womb. When the child is born, the placenta, which resembles a pancake in shape, measures about 7 inches in diameter and is about 1 inch thick, weighing approximately one-sixth the weight of the baby. This organ performs for the baby in the womb practically all the functions which the child must perform for itself after it is born. Thus the placenta acts as the organs of respiration, digestion, excretion, and circulation.

The placenta is made up of myriads of tiny finger-like projections known as villi, which dip into a space containing blood of the mother. These villi are part of the development of the fetus, hence the placenta is fetal in origin. The villi remove from the mother's blood the material which the child requires for its nourishment and growth and they likewise form an anchor by means of which the placenta is attached to the interior of the womb. The placental surface of attachment is spoken of as the maternal surface, whereas the opposite side is termed the fetal surface because it is directed toward the fetus, which lies in a sac of fluid known as liquor amnii. The lining of the sac, known as the membranes or bag of waters, is attached to the fetal surface of the after-birth.

The child moves around in the sac of liquor amnii, but is attached to the placenta by means of a long, thin tube of tissue known as the umbilical cord. The latter structure usually contains one artery and two veins which transport the blood. The placenta also acts as a barrier against the passage of certain diseases from the mother to the child in the womb. On the other hand it permits the passage of drugs and protective antibodies against diseases. J. P. G.

PLACER MINING. See MINING, PLACER.

PLACERS, deposits of ore minerals formed by natural stream action. The WEATHERING of an ORE DEPOSIT breaks down the rocks and GANGUE, and if the ore minerals are resistant to weathering, they are

liberated and transported by running water. Heavy minerals, such as gold, platinum, cassiterite and magnetite, settle quickly to the bottom of the stream bed, with the heavier rock particles, while the comparatively lighter, silt is swept downstream. Thus there is produced a natural concentration of the valuable minerals by processes which man imitates in his gravity concentration of ores. In this manner a mineral too thinly disseminated through rock to be mined may be concentrated and made worth exploiting by PLACER-MINING methods.

PLACERVILLE, a town in Eldorado Co., north-east central California. It is situated near the American River, 40 mi. northeast of Sacramento on the Southern Pacific Railroad. The surrounding region is noted for its especially fine fruit. The district has large tracts of timber, and lumber industries are the leading interests of the town. Placerville received its name because of the placer gold found in this region in the early days. Pop 1920, 1,650; 1930, 2,322.

PLAGIOCLASE, a subdivision of the general group of FELDSPARS, which are important rock-forming minerals. The colors are usually light, such as white, gray, reddish, bluish, greenish, and brown. The plagioclase feldspars include ALBITE, a sodium aluminium silicate, and ANORTHITE, a calcium aluminium silicate. Mixtures of these two occur in all proportions, and proceeding in the direction of increasing anorthite, they are known as oligoclase, andesine, labradorite and bytownite. Crystallization is in the TRICLINIC SYSTEM. Labradorite is often distinguished by a beautiful play of colors. It and the MOONSTONE and SUNSTONE varieties of OLIGOCASE are used as semiprecious stones, and in decorative work.

The plagioclases are characteristic of the monzonite, diorite, and gabbro groups of igneous rocks. They frequently show fine striations, due to multiple twinning, by which they may be differentiated from other feldspars. See AVENTURINE; GEM STONES; PETROLOGY.

PLAGUE, a severe infectious disease caused by the *Bacillus pestis*, which is carried to man from infected rats by the rat flea. This is apparently the only way in which the disease is transmitted. Epidemics of plague in man can generally be shown to follow by several weeks similar outbreaks in rats. Great pandemics have been recorded, and still occur in China, India, and tropical countries. (See also TROPICAL DISEASES.)

The disease occurs in three forms: *bubonic*, *pneumonic*, and *septicemic*. Of these, the bubonic is the most common. The lymph nodes of the groin enlarge and hemorrhages in other organs occur. Other lymph nodes become infected, and patchy hemorrhages develop on the skin. The patient is rapidly prostrated by fever, delirium, and convulsions. Seventy per cent of the cases die within a week.

The other two forms are invariably fatal. The pneumonic type is characterized by severe fever, coughing, and a rapidly failing heart. The symptoms of the septicemic type are very severe and death usually supervenes during the first day.

Prophylaxis is the most valuable method of attack. Rat-killing drives, however, apparently have little real effect. Rat-proofing of houses is the most permanent and efficacious mode of prevention. A specific vaccine will protect most persons for a month or two. There is little agreement as to the best method of treatment, but the use of a specific serum is perhaps the best therapeutic measure. Careful nursing is essential, as strain on the heart must be avoided during recovery. *See also* ENTOMOLOGY, MEDICAL: Mechanical Carriers.

PLAICE, in Europe a flatfish (*Pleuronectes platessa*), highly valued as food, ranging from the North Sea to England. Its broad body, from 12 to 18 in. long, is mainly brown, covered with large orange spots, which extend around the fins. The plaice is often found close to shore on sandy bottoms, where it feeds principally on shell fish and mollusks. Commercial fishermen prefer trawl nets in catching this fish, but sometimes the hook and line are used. The name plaice is sometimes given to the summer flounder (*Paralichthys dentatus*) in the United States. It is common on the Atlantic coast from Massachusetts southward. It grows to be 3 ft. long.

PLAIN, a large level tract of land. Much of the land surface of every continent is occupied by plains. Many of these, as the great coastal plains and the interior prairie lands, represent upraised sea-bottoms or the floor of extinct glacial lakes. Others, formed of river-borne sediment, are known as FLOOD-PLAINS or delta plains, or, if of glacial origin, OUTWASH PLAINS.

Theoretically any land area, if undisturbed, would be ultimately reduced by erosion to a surface approximating sea-level. Traces of such extensive leveling of the land in past geological time are detectable in New England and other regions which have since been re-elevated.

PLAINFIELD, a city of Union Co., N.J., situated near the base of the Watchung Mountains, 23 mi. southwest of New York City. It is served by the Central of New Jersey, Baltimore and Ohio and the Reading railroads, electric trolleys and motor bus lines. It is mainly a residential suburb with many fine homes and a number of parks, playgrounds and buildings devoted to community interests. It is the trading center for a district of suburban communities and country homes and has a number of important industries, including the manufacture of automobile trucks, printing presses, broad silks and hosiery. In 1929 the value of the factory output was about \$14,000,000; the retail trade amounted to \$32,281,752. It was settled about 1684 and was separated from Westfield township in 1847. It was incorporated as a city in 1869. Pop. 1920, 27,700; 1930, 34,422.

PLAINTIFF. One who brings an action at law. Originally plaintiff was used in actions at law, complainant in suits in equity, and libellant in proceedings in admiralty and divorce. To-day the term plaintiff has generally superseded these, especially in jurisdictions in which jurisdiction at law, in equity, and in divorce is consolidated in one court and exercised in one type of proceeding. Under the

older procedure which obtains in some jurisdictions, where the assignee of a claim is not allowed to sue in his own name, the action is brought in the name of the assignor for the use of the assignee, and in that case the assignee is called the use-plaintiff.

PLAINVIEW, a city and the county seat of Hale Co. in northwestern Texas, situated 72 mi. south of Amarillo. Bus lines and two railroads serve the city. Besides dairying and the poultry industry the surrounding district produces cotton, grain and sorghum. The countryside is especially fertile; many acres of this Panhandle country have never been farmed but it is essentially a growing district. The principal industries of Plainview are milk products manufacture and flour and cotton-seed milling. The city was founded in 1887 and incorporated in 1907 with the coming of the railroad. Pop. 1920, 3,989; 1930, 8,834.

PLAN, in architecture, a horizontal section of a building at any given level. The plan is the most important of all the possible drawings of a building, as it shows not only the relationships of all the rooms or spaces, and their doors and windows, but also the positions of the supports, buttresses and other parts. To the trained eye a plan can suggest the entire constructive system and much of the interior and exterior effect. In order to give as much information as possible in a simple manner, the indication on a plan of various elements has become generally standardized. The solids of walls and piers are often blackened or darkened. Doors appear as simple breaks or open spaces; door swings are indicated by a segment of a circle, with a thin line at an angle, representing the door itself. Windows are indicated by an opening with one, two or three light lines drawn across it. If the windows are casements, their swing may be indicated like the swing of doors. The position of arches or beams in the ceiling above may be shown by light or dotted lines.

In a large and elaborate plan, bases of walls and columns may be drawn, and the patterns of floors. Occasionally, the shapes of vaults are indicated by dotted curves of the same type and radius as the vault section. Thus a rectangular room with a semicircular barrel vault would have two dotted semicircles drawn projecting inward from the end walls. In modern architectural working drawings there is also an indication of material, by means of dotting, hatching, shading, etc., and also conventionalized indication of the position of mechanical equipment, such as electric outlets, plumbing fixtures and heating elements, etc. The whole plan will be accurately dimensioned, the exact run of each figured dimension being shown by arrow heads and thin lines.

PLANCHETTE. *See* OUIJA BOARD.

PLANCK, MAX (1858-), German physicist, was born at Kiel, Apr. 23, 1858. He became professor of mathematical physics at Kiel University in 1885, and from 1889 to 1923 was professor at Berlin University and director of the Institute of Theoretical Physics. In 1894 he was elected a member of the Berlin Academy. He worked upon energetics and

thermodynamics, particularly upon the second law, concerning entropy, and advanced the quantum theory, in which energy may be said to be considered as of atomic structure, having an indivisible unit less than which is nothing. He received the Nobel Prize in physics in 1918.

PLANCK'S CONSTANT. See LINE SPECTRUM.

PLANCK'S LAW gives the distribution of energy in terms of the WAVE-LENGTH in the spectrum of the BLACK BODY RADIATION. It is expressed by the equation

$$E\lambda = C_1 \lambda^{-5} \frac{1}{e^{c_2/2T} - 1}$$

where $E\lambda$ denotes the energy of wave-length, λ , emitted by a black body at absolute temperature, T , c_1 and c_2 are constants and e is 2.7182818. It was this study of the distribution of black body radiation that first led PLANCK to suggest that energy exists only in discrete quanta. (See QUANTUM THEORY.)

W. W. S.

PLANE FIGURES, figures lying in the same plane. They may be classified as rectilinear, composed of straight lines, or curvilinear, composed of curve lines. In elementary geometry the rectilinear figures most commonly used are (1) closed, including triangles, quadrilaterals and other polygons, or (2) non-closed, such as parallel lines or a pair of intersecting lines. The curvilinear figure most commonly used is the ellipse, of which the circle is a special type; the parabola, and, less frequently, the hyperbola. The most common of these figures are discussed under their several heads in this encyclopedia. See GEOMETRY; CONICS; POLYGON; FIGURES.

PLANERS, machines for planing a surface on metal or wood. On metal work single point tools are used in each head, and the work, held on a transversing table, passes under the tools. While the planer of 25 years ago was comparatively simple, the modern machine has been developed in each of its details. Every motion can now be controlled by the operator from a single point. Every part, such as the rail and all the tool heads, can be moved by power at the touch of a button. The rail is clamped and unlocked by power and the wearing parts have automatic lubrication. Some modern planers require a motor of at least 100 horsepower.

Wood working planers are entirely different. They have revolving knives or cutters, similar to a MILLING MACHINE. They are less highly developed because wood products do not demand the same accuracy. See MACHINE TOOLS; also WOOD WORKING MACHINES.

F. H. C.

PLANNER TREE (*Planera aquatica*), a small tree of the elm family called also water-elm. It is native to moist soils in the southern United States and sparingly planted for ornament. It grows sometimes 40 ft. high, with smooth, somewhat leathery, toothed leaves, conspicuous flowers, and small nutlike fruit.

PLANET, a body attendant upon the sun, and revolving around it. Seen from the earth the planets

appear to be moving among the stars. At present nine are known, viz. Mercury, Venus, the Earth, Mars, Jupiter, Saturn, Uranus, Neptune and Pluto, given in order of distance from the sun. The first four are usually named the terrestrial planets; the next four the major planets, because of their much greater size. Pluto, a very recent discovery, is comparable in size with the terrestrial planets.

Seen from the earth, Mercury, Venus, Mars, Jupiter and Saturn appear at least as bright as stars of the first magnitude. Uranus may occasionally be seen with the unaided eye, while the other two are invisible except through a telescope. All planets except Pluto revolve in elliptical orbits not differing greatly from circles, and the planes of their orbits do not make large angles with each other. They are non-luminous bodies shining only by the reflected light of the sun. Mercury and Venus, which move inside the earth's orbit, present phases similar to those of the moon.

Between the orbits of Mars and Jupiter more than a thousand small objects have been discovered which also revolve around the sun. They are generally called asteroids because of their small size and star-like appearance.

W. J. L.

PLANE TABLE. See SURVEYING.

PLANETARIUM, originally, the name given to a mechanical model illustrating the motions of the planets in the solar system. Generally, it is so constructed that each planet is represented by a small sphere placed at the end of a rod, connected with the center, and moved by clockwork and a complicated system of gears in such a way that the times of completing one revolution are relatively correct for each planet. The lengths of the rods likewise are correct representations of the relative distances of the planets from the sun. Owing to the nature of the problem, the sizes of the spheres are highly exaggerated, since actually the diameter of a planet stands to its distance from the sun in a ratio of at least from 1:5,000. Taking planet for planet, however, their mutual sizes are relatively correct. By an additional system of gears, the rotation of the earth on its axis as well as the motion of the moon around the earth can be indicated. Models of this type are sometimes called orreries, after the famous model by the Earl of Orr.

In recent years, an entirely new type of planetarium has come into being, constructed by the firm of Carl Zeiss, in which the motions of the heavenly bodies are shown by optical methods in projecting images upon the inside of a huge hemispherical dome, which thus serves as an artificial sky. The spectator stands near the center of this dome, and practical experience has shown that if its radius is of a magnitude of 25 ft. or more, the effect produced looks remarkably real. The actual apparatus consists of an ingeniously devised and exceedingly complicated machine whereby an intricate arrangement of small but intense electric lamps, together with a system of lenses, project the images of sun, moon, planets and stars upon the concave surface of the dome. The projectors of the star images remain fixed relatively to each other, but the

whole may be made to revolve about an axis parallel to the earth's axis to produce the effects of rising and setting. The images of the sun, moon and planets are moved, by means of an intricate system of gears, in such a way that the spot of light as projected upon the dome moves exactly as the particular heavenly object, as seen from the earth, moves in the sky.

An unusual feature of this type of planetarium is that the driving mechanism may be speeded up to such an extent that the equivalent of hundreds of years' motion in the sky may be shown in a few minutes, thus giving a very vivid demonstration of the reality of some of the slower periodic movements in the planetary system, such as precession and nutation. The Zeiss planetarium has met with much success abroad and has been established in several cities in Germany, as well as in many of the capitals of central and eastern Europe. In the United States, Chicago possesses one in the Adler planetarium; another is under construction at Los Angeles; and a third at Philadelphia. W. J. L.

PLANETESIMAL THEORY, the hypothesis explaining the origin of the solar system by the encounter of two stars resulting in swarms of very small bodies. In somewhat modified form it is also called the theory of dynamic encounter.

PLANETOIDS, or **ASTEROIDS**, the name given to the many small bodies that revolve about the sun between the orbits of Mars and Jupiter.

PLANE TREE, the general name for a genus (*Platanus*) of forest trees, several forms of which are widely grown for ornament. There are 3 species found chiefly in north temperate regions; of these 3 are native to North America. They are mostly massive trees with exfoliating bark and widespreading branches, white more or less mottled with gray, and large, broad, palmately lobed leaves. The flowers are borne in dense globular heads, as are also the ichene-like fruits. The oriental plane (*P. orientalis*), native from southeastern Europe to India, is planted as a street tree but far less commonly than the London plane (*P. acerifolia*), supposed to be a hybrid between the oriental and the American plane (*P. occidentalis*). In the United States the native plane trees are commonly called SYCAMORE.

PLANIMETRY, the measurement of plane surfaces, such as the triangle, quadrilateral, trapezoid, circle and ellipse. See MENSURATION.

PLANKTON, the name applied to all forms of marine life having no means of propelling themselves, and which merely drift around with the currents and wind. It comprises some large plants, such as gulfweed, the chief constituent of the SARGASSO SEA; some fairly large animals; molluscs, such as the pteropods or "whale feed"; medusae and nautilus. But for the largest part it is microscopic, comprising eggs and spermatozoa of fishes and other spawning animals, and a vast amount of unicellular organisms, such as protozoa, foraminifera, radiolaria and especially diatoms. Sometimes a distinction is made between macroplankton and microplankton, the former being retained by filtering

through fine silk while the latter runs through the very finest filters. Other divisions are the oceanic and neritic plankton, the latter being that of the coast regions; the epiplankton at the surface, and the bathyplankton at greater depths.

Plankton is scarce in tropical seas and most abundant on the border of the temperate zones and the arctic, where there may be more than 10,000 organisms per cubic inch of sea water. It is of great importance in that it provides food for many varieties of fish, almost the only food for deep-sea creatures. The vegetable plankton binds the carbon dioxide of the air into carbohydrates, the only real food-producing process in nature. It has been estimated that the oceanic yield is about 10 tons of vegetable matter per acre per season.

PLANNING AND SCHEDULING. See INDUSTRIAL MANAGEMENT.

PLANTAGENETS. See ANGEVINS.

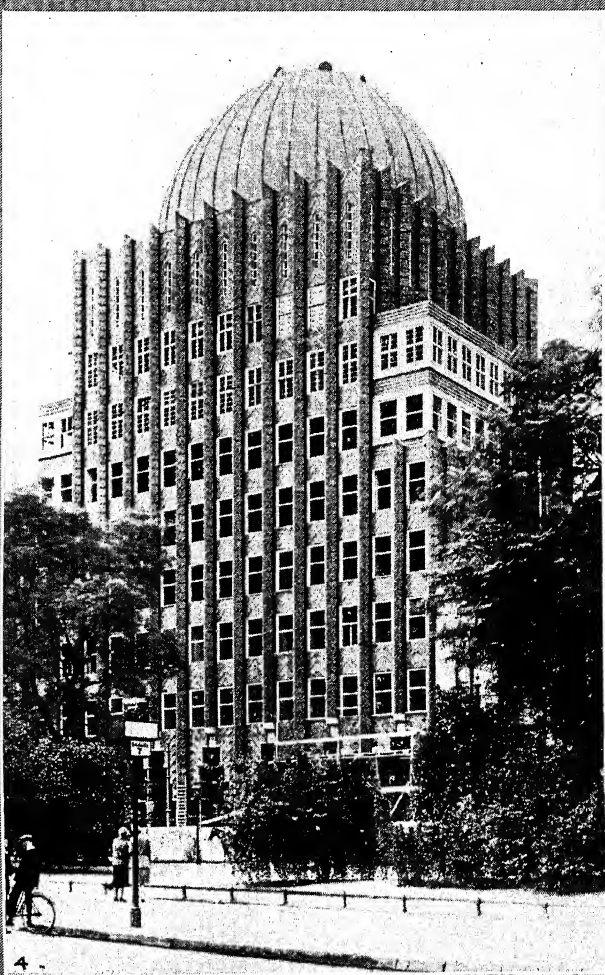
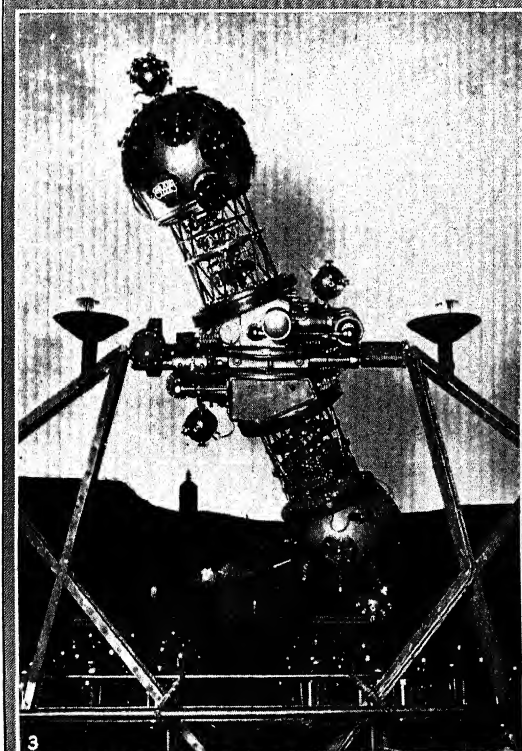
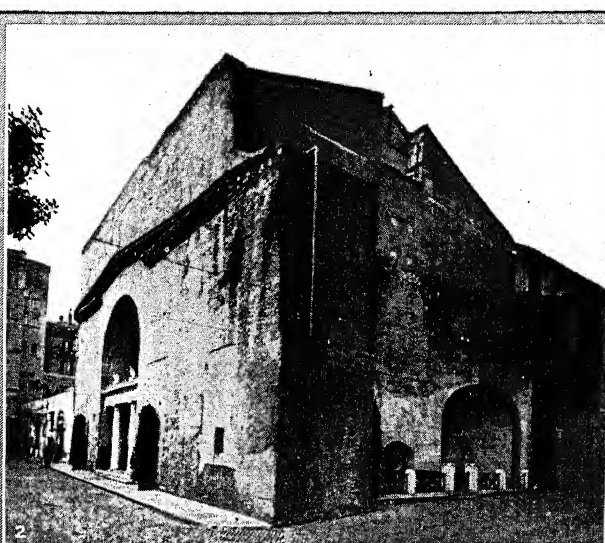
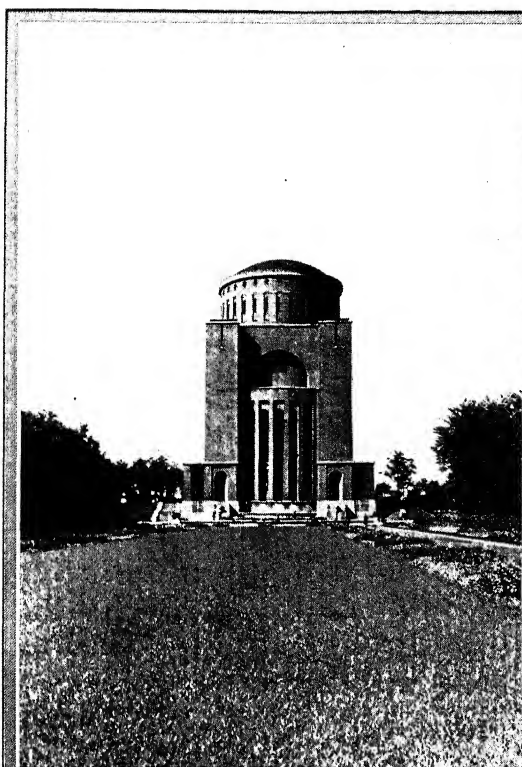
PLANTAIN, in temperate regions the name applied to a numerous genus (*Plantago*) of small annual and perennial plants. It comprises 200 species of very wide distribution, many of which are common weeds, as the dooryard plantain (*P. major*), a stemless perennial with a rosette of basal leaves and a long narrow flowering spike, and the English plantain or rib-grass (*P. lanceolata*). In tropical countries the name plantain is applied to a large banana-like plant (*Musa paradisiaca*). It grows 10 to 30 ft. high with a thick stem and large, nearly erect leaves, 5 to 9 ft. long. The hard, strongly angled, yellowish fruit, borne in drooping clusters 2 to 5 ft. long, resembles the common banana in appearance but is less sweet, more starchy and edible only when cooked. It forms a staple article of food in many tropical countries.

PLANTAIN-EATERS, known also as touracos, a numerous family (*Musophagidae*) of brilliantly colored African birds allied to the cuckoos. They are of large size, ranging from 15 to 30 in. in length, with helmet-like crests, which they elevate when excited, and stout, thick serrated bills. The sexes are alike in plumage, the predominant colors being bright green, blue, brown, crimson and yellow. Noisy and restless, plantain-eaters move in pairs or small companies, inhabiting for the most part the tops of the highest forest trees. Their food consists largely of fruits, of which the banana or plantain, the tamarind and various plumlike fruits are most important. Representative species are the common plantain-eater (*Musophaga violacea*) of western Africa, with purple and crimson plumage; the touraco (*Turacus purpurus*) of similar range, with purple



DRAWING BY GEORGE MIKSCH SUTTON
PLANTAIN-EATER OR TOURACO

PLANETARIUM



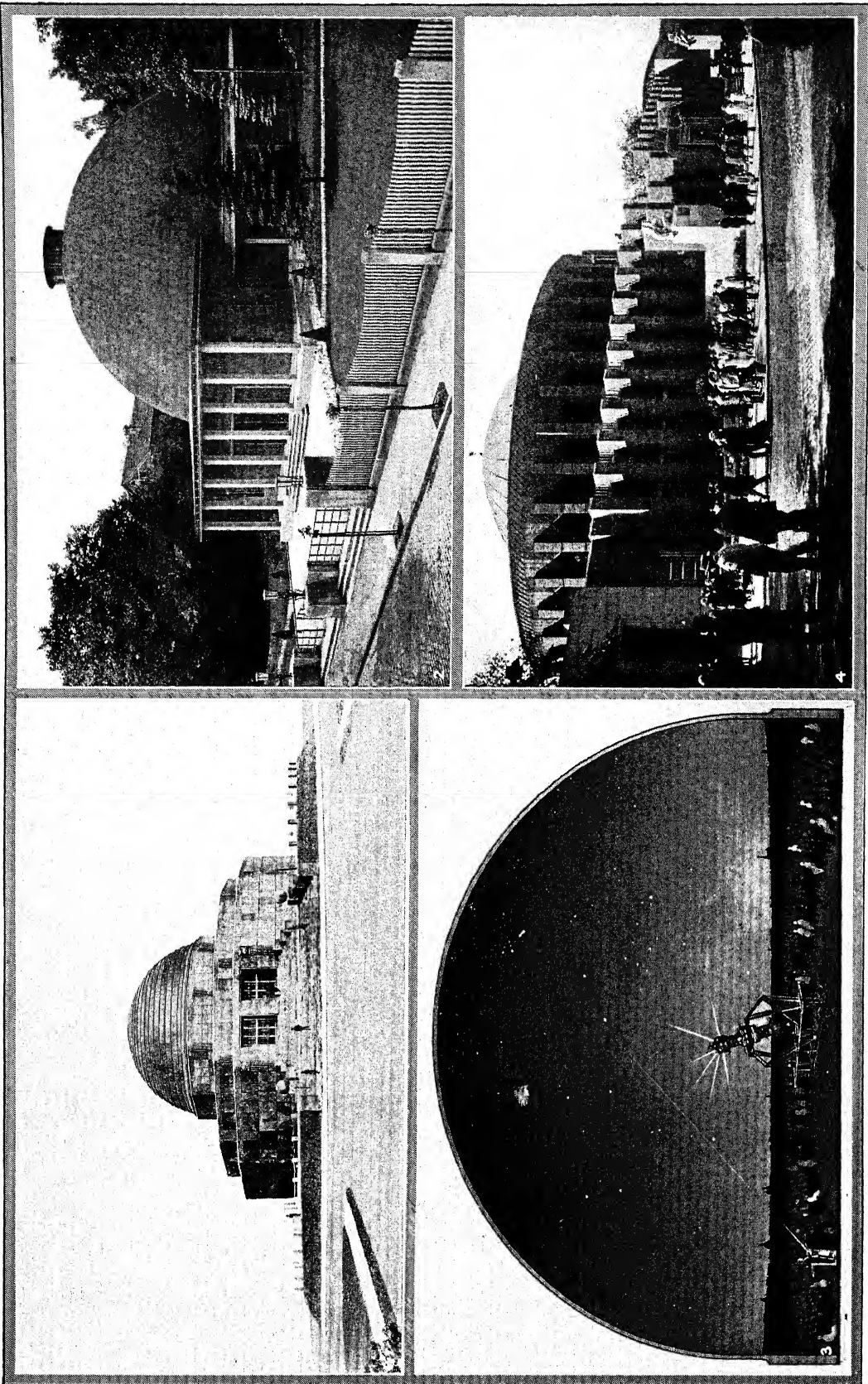
COURTESY CARL ZEISS, INC., NEW YORK CITY

PLANETARIUMS OF CONTINENTAL CITIES

1. City-owned planetarium, Hamburg. 2. State-owned planetarium, Rome, in the Hall of Minerva in the ancient Baths of Diocletian. 3. Great projecting instrument with

the axis perpendicular to the plane of the earth's orbit. The instrument is 14 ft. high. 4. Newspaper building of Hanover which is surmounted by a planetarium.

PLANETARIUM



AMERICAN AND GERMAN PLANETARIUMS

1. Adler Planetarium, Chicago, the first erected in the United States.
2. Planetarium Building in the Princess Garden, Jena, Germany.
3. Inside the hemispherical projection chamber, showing planetarium in use.
4. Municipal Planetarium, Düsseldorf, with dome of reinforced concrete.

and green plumage, and the great plantain-eater (*Corythæla cristata*) of West and equatorial Africa nearly 30 in. long, with greenish blue plumage. Plantain-eaters are unique in that the outer rather than the inner toe is reversible and in the presence of a green pigment in their feathers.

PLANT BREEDING, the effort to improve inherited characteristics of plants. Plant improvement may result either from breeding or from improved cultural practices. The former tends to induce a permanent change in the plant, while the latter affects the plant only so long as the particular cultural practice is continued.

The purpose of plant breeding is for a better adaptation to satisfy human needs. Thus, with one plant the end that is sought might be ability to respond by increased grain yield; with another it might be improved flavor of fruit; with a third, increased cold resistance or disease resistance; while with a fourth it might be increased beauty or luxuriance of foliage or flowers for ornamental purposes. It frequently occurs that the processes by which such improvement is brought about produce a plant with reduced ability to survive and propagate under natural conditions.

There is no conclusive evidence that man, in his breeding operations, can create anything new except new combinations of inherited characteristics or tendencies already in existence. Treatment of germ cells with radium may increase the rate at which aberrant types (sports) arise, but there is no evidence that the types so produced are inherently different from those that appear occasionally under natural conditions.

Methods used in plant breeding may be considered under three types, namely, asexual propagation, self-fertilization and cross-fertilization. With many plants more than one of these types of propagation may be utilized in the breeding program. Asexual propagation is a term used to designate those processes by which grafted or rooted cuttings, or other multicellular pieces of the parent plant, are induced to develop into new plants. Self-fertilization occurs when the egg cell of a plant is fertilized by its own pollen. Hence, the offspring have only one parent. Cross-fertilization occurs when the egg cells of a plant are fertilized by pollen from another plant.

The first type of breeding program to be considered is a type which is adapted to all plants that may be propagated economically by asexual means. Such plants include most of the trees, shrubs, brambles, bulbs, tuberous or stoloniferous plants and perennials which produce storage roots. With such plants any individual which possesses great merit may be multiplied indefinitely by asexual means. This type of propagation produces offspring that have hereditary characteristics identical with those of the parent. Thus every Baldwin apple tree, wherever it grows, arises from a multicellular piece of, and hence is hereditarily identical with, the original tree of this variety. (See CLOVER.) Therefore, with plants that lend themselves readily to asexual reproduction it is necessary only to find or to produce a desirable individual.

Most of the earlier varieties of such plants were found as wild seedlings. Others were found as bud sports. That is, for instance, a single branch from a tree of one variety of apple would be found to bear fruit differing, in appearance or in flavor, from the variety in which this branch arose. More and more of recent varieties have been produced artificially. Usually the initial step in planned production of new varieties is an artificial cross between varieties or between species. The pollen from the one variety is used to fertilize the egg cells of the other. Usually the seedlings arising from a cross between two varieties are widely different from each other because the parents themselves have arisen from divergent stocks. That particular seedling which combines most completely the desirable characteristics of both parents is selected as a new variety to be propagated asexually. Frequently such artificial crossing is practiced to effect a combination of cold resistance with other desirable qualities in order that the range of commercial production may be extended into cold regions. At other times the same process is made use of to effect a combination of disease resistance of a variety possessing low commercial quality with high quality of a susceptible variety.

A seedless fruit, such as the commercial banana, can be improved only to the extent that superior bud sports are discovered within the variety.

The second type of breeding program to be considered is a type adapted to all plants that normally are self-fertilized and are not propagated economically by asexual means. Self-fertilization is the rule among some flowers, many of the cultivated legumes, and many grasses, including most of the cereals. The occasional natural cross which takes place between varieties induces a high degree of variability among the progeny of such crossed plants. The self-fertilization which follows normally causes the stock to break into many pure lines. Each pure line comprises all plants that are practically identical in their hereditary characteristics. The mixture of many such pure lines constitutes the variety. Of all the pure lines which exist within a variety, some may be better adapted than others to a given soil, climate or peculiar set of environmental conditions. All the progeny of any single homozygotic plant propagated exclusively by self-fertilization represents one pure line. This conception of a pure line was introduced by Johannsen. Many single plants are isolated and progenies of the different single plants are multiplied by self-fertilization until there is enough seed of each so that the different pure lines may be compared in adjacent plots. After many comparisons the pure line which seems to be best adapted under the given conditions is increased and disseminated as a new strain of the variety. Frequently each of two known varieties possesses desirable qualities that are lacking in the other. Under such conditions it is desirable to produce a single variety which possesses the wanted characteristics of both of the old ones. An artificial cross is made between the old varieties and the progeny permitted to grow in mass through a number of genera-

tions until natural self-fertilization has created many pure lines within the mass. Then pure lines are isolated and compared by the methods mentioned previously. When only a single characteristic of variety *a* is to be combined with all remaining characteristics of variety *b*, the second generation from the cross between *a* and *b* may be examined to isolate those plants which possess the one desirable characteristic of *a*. These isolated plants, in turn, may be back-crossed to *b*. A continuation of this process through several back crosses tends to produce a type similar to *b*, with the exception of the single characteristic introduced from *a*.

The third type of breeding program to be considered is a type adapted to all plants that normally are cross-fertilized and are not propagated economically by asexual means. Corn or maize is a prominent member of this group. For many years mass selection has been practiced among such plants. That is, seed for planting is obtained by selecting those individuals which show most desirable characteristics. The seed from many such individuals is mixed in one mass. Either crossing plants that are closely related, or self-fertilizing, where cross-fertilization normally occurs, usually results in loss of vigor. Therefore, in the production of commercial seed, either these practices are avoided or their detrimental effects should be overcome. Many methods have been tried. One, which occupies a prominent position, comprises artificial self-fertilization to produce pure lines and final crossing of the most promising pure lines. If qualities other than yield constitute the most prominent objective, a synthetic variety may be created by mixing a number of pure lines, all of which show the desired qualities. When yield is the important consideration, many pure lines are crossed one with another until two lines are found which produce a high-yielding first generation cross. Thereafter these two pure lines are maintained separately and crossed each year to produce seed for planting. Because inbred lines lack vigor, seed yield is low in the crossing plot. To overcome this objection two different single crosses, that have been tested, may be maintained in isolation and crossed to produce double crossed seed for commercial planting.

W. B. K.

BIBLIOGRAPHY.—Bailey and Gilbert, *Plant Breeding*, 1915; Hayes and Garber, *Breeding Crop Plants*, 1927.

PLANT CITY, a city in western Florida, in Hillsborough Co., situated 22 mi. east of Tampa. The Atlantic Coast Line and the Seaboard Air Line railroads serve the city. Phosphate mines are found here. The local manufactures are novelties, crates, baskets and lumber products. The principal crop is strawberries, others being oranges, celery and truck products. Pop. 1920, 3,729; 1930, 6,800.

PLANT CLASSIFICATION, the grouping of individual plants into successively larger categories, each under an appropriate name, until the largest, the Plant Kingdom, includes all plants together. Particularly, it enables one to speak of a large number of individuals under a single term, a purpose also met by

such common terms as palm, root-crops, tree; scientifically, classification is intended to indicate the course of plant evolution and to show approximately the degree of genetic relationship between plants, the smaller categories denoting an intimate relationship and the larger ones progressively more distant kinship. Numerous systems of classification have been proposed during the past two centuries, each reflecting the state of botanical knowledge at the time and each influenced in some degree by the opinion of the author as to the significance of that knowledge. Before the general acceptance of the principle of organic evolution in the second half of the last century, these systems were usually based on various external structural features of plants. The modern tendency in classification is to utilize any and all features of the plant which are believed to indicate its relationship, and to build up a system of classification synthetically rather than to divide and subdivide the plant kingdom analytically.

Certain categories of classification are regularly adopted by botanists. The fundamental group is the species, which may be loosely defined as a number of individuals essentially similar in all features of structure and behavior. A precise definition of species has not been given and botanists often disagree in interpretation of their scope. A group of similar species (or only one species without similar forms) constitutes a genus; one or more genera a family; families are grouped into orders; the categories above the rank of order are not uniformly named.

The following system of classification, although not the most modern, is very convenient as a general exposition of the plant kingdom. The most primitive group appears first.

DIVISION I. *Thallophyta*, the thallus-plants. Plants sometimes microscopic, unsegmented or scarcely segmented; sexual reproduction none, or isogamous, or heterogamous, the female organ never an archegonium; dominant stage gametophytic, the sporophytic generation none or poorly developed.

Class 1. *Algæ*, the seaweeds and their relatives. Autonomous plants, capable of producing their own food.

Class 2. *Fungi*, the bacteria, moulds, mildews, rusts, smuts, and mushrooms. Parasitic or saprophytic plants.

In the three following divisions, the plant body is macroscopic and usually segmented; sexual reproduction heterogamous, the female organ an archegonium; sporophytic generation well-developed.

DIVISION II. *Bryophyta*, the moss-plants. Vascular tissue mostly none; sporophyte parasitic on the dominant and highly developed gametophyte.

Class 1. *Hepaticæ*, the liverworts.

Class 2. *Musci*, the mosses.

In the remaining divisions vascular tissue is well-developed and the autonomous sporophyte is the dominant stage.

DIVISION III. *Pteridophyta*, the fern-plants. Gametophyte well developed and autonomous; sporophyte homosporous or heterosporous; seeds and flowers not developed.

Class 1. *Filicales*, the true ferns.

Class 2. *Articulatæ*. Extinct.

Class 3. *Lycopodiales*, the club-mosses.

Class 4. *Psilotales*, *Psilotum* and its relatives.

Class 5. *Isætales*, the quillworts.

DIVISION IV. *Spermatophyta*, the seed-plants. Gametophyte reduced and parasitic on the heterosporous sporophyte; seed developed.

Subdivision I. *Gymnospermæ*, the gymnosperms. Seeds produced on open sporophylls.

Class 1. *Cycadofilicales*. Extinct.

Class 2. *Cycadales*, the cycads.

Class 3. *Bennettitales*. Extinct.

Class 4. *Ginkgoales*, the ginkgo tree.

Class 5. *Coniferales*, pines and their relatives.

Class 6. *Cordaitales*. Extinct.

Class 7. *Gnetales*, *Gnetum* and its relatives.

Subdivision 2. *Angiospermæ*, the angiosperms or true flowering plants. Seeds produced within the closed ovary.

Class 1. *Monocotyledoneæ*, the monocotyledons, including about one-fifth of all flowering plants. Seed-leaf one in each seed.

Class 2. *Dicotyledoneæ*, the dicotyledons, including about four-fifths of all flowering plants. Seed-leaves normally two. H. A. G.

PLANT DISEASES. All plant species that have been carefully studied are known to suffer from a variety of different diseases. The diseases of economic plants have received most attention but weeds and other wild species are also subject to a wide range of disorders. Plant diseases are in many respects similar to those of man and animals. From the standpoint of etiology they may be divided into parasitic and non-parasitic diseases.

The parasitic diseases are due to organisms that live as parasites on plants. These organisms belong to many different species of animals and plants. Mites, nematodes and insects are some of the most common animal parasites but certain protozoa also parasitize plants. Primitive organisms known as slime molds, bacteria and fungi are the most common plant parasites. Numerous instances of seed plants that live as parasites on others are, however, well known.

The slime molds are organisms that occupy a very low position in the plant kingdom. The vegetative stage in the life history of a slime mold is a naked mass of protoplasm known as a plasmodium. Most of the slime molds live as saprophages on decaying wood or other dead materials. A few are parasitic and cause such well-known diseases as the club root of cabbage and the powdery scab of potato. Although of great scientific interest the slime molds are not important from a pathological standpoint because so few of the species are parasitic. In this respect slime molds stand in sharp contrast to the bacteria.

A large number of bacterial species are parasitic on plants. Approximately 175 have been described but there are, no doubt, many parasitic species that have not yet been discovered. Annual losses amounting to millions of dollars are caused by bacterial pathogens in field and garden crops. One or more species attack such important economic plants as apple, barley, beans, corn, cotton, cowpea, oats, potato, rice, sugar cane, tobacco, tomato and wheat. There are no important crops that are unaffected by bacterial diseases. Bacteria are known to parasitize about 150 genera distributed in more than 50 families of plants.

High temperatures, high humidity and excessive shade are conditions that favor infection by parasitic bacteria. They attack young and succulent tissues far more readily than the woody parts of plants. Roots, stems, leaves, flowers and fruits are all subject to infection. In most instances the bacteria occupy the intercellular spaces, but in a few cases they are intracellular. Many cause lesions in parenchymatous tissues, while some invade the vascular strands and are therefore termed vascular parasites.

One of the most common symptoms of bacterial diseases is dwarfing. Color changes of various kinds occur in the affected organs. The tissues that are invaded usually die. Bacterial diseases cause cankers, tubercles, tumors, wilts, leaf spots, soft rots, twig blights, chloroses and various other types of injury. Most of the parasitic bacteria are small rod-shaped organisms. Many are actively motile and a smaller number are non-motile. Few, if any, produce endospores. They readily grow in artificial culture media.

Bacterial diseases are spread through the shipment of seeds, bulbs, tubers, plants and parts of plants, living and dead. They are spread locally by wind, rain, farm machinery, farm animals, insects, birds and man.

The most important control measures consist in the removal and destruction of affected plants when present among healthy plants, the use of disease-free seed or propagating stocks, the treatment of seeds with chemical agents, the protection of plants with sprays and dusts, the use of resistant varieties and the practice of crop rotation.

Although the bacterial parasites of plants are numerous and destructive they are, from a pathological standpoint, far less important than the fungi. The fungi are of such overwhelming significance as pathogens that by some authors plant pathology is treated as a part of the subject of mycology. The fungi cause more important plant diseases than all of the other groups of parasites.

The vegetative body in the fungi consists typically of a more or less branched filament showing apical growth. The filamentous body is known as the mycelium. It may or may not be divided into cells. Many different kinds of spores are produced, but they are, in general, of two kinds, sexual and asexual. All spores serve to reproduce and to multiply the species. Sexual spores are commonly resting spores capable of keeping alive during periods unfavorable for growth. All fungi, including those that are parasitic, are be-

lieved to belong in three classes, the Phycomycetes, the Ascomycetes and the Basidiomycetes. The sexual or perfect stage is unknown for many fungi. Therefore they can not be properly classified. Such organisms have been placed together in a group known as the *Fungi Imperfecti*.

The parasites which cause the black wart disease of potato and the late blight of potato are Phycomycetes. A large group of fungi that cause wilt diseases in such important crops as tomato, cabbage, potato and cotton belong in the Ascomycetes. The powdery mildews and the fungus causing the destructive chestnut blight disease are also Ascomycetes. The rusts and smuts which cause so much damage to cereal crops are Basidiomycetes. Parasites belonging in the *Fungi Imperfecti* cause numerous leaf spot diseases.

Much of the spraying and dusting of plants is for the purpose of checking or preventing damage from parasitic fungi. From an economic standpoint the most important property of many chemicals is their fungicidal activity. Crop rotation and use of immune or resistant varieties are other effective control measures.

It would not be appropriate to close a discussion of plant parasites without mention of the filterable viruses. These agents pass readily through porcelain filters and are believed to be so small that they fall below the range of vision permitted by the most powerful microscopes. They have never been observed and are not definitely known to be living organisms, so that they can not be assigned a place among the plant parasites. It may be stated, however, that in infection and disease they behave like parasites. The virus diseases are of great economic importance. Resistant varieties are sometimes employed to keep them in check. Since they are quite generally spread by insects their control is frequently dependent on the control of an insect vector.

The non-parasitic diseases of plants are due to hereditary weaknesses and to innumerable environmental factors. The soil in which plants grow may be too acid or too alkaline in reaction, or it may not have sufficient humus. Too much iron or other deleterious substances may be present. It may be too wet or too dry or may not furnish enough of the nutrient elements. The soil solution may be unbalanced due to the presence of nutrients in improper proportions. Injuries may result from the presence of gas, smoke or fumes in the air of industrial regions or from poisonous chemicals that may escape into streams or be otherwise carelessly disposed of in the process of manufacture. They also result from mechanical disturbances or the violent action of such agencies as high winds, heavy snows or sleet, hail and lightning. All of these unfavorable factors affect the growth and development of plants. They may cause slight abnormalities, disease or even death.

L. O. K.

PLANTERS, implements which deposit seeds in the ground at the desired depth, and spacing. The different types include corn planters, cotton planters, potato planters, grain drills (see separate titles on these subjects). Most planters consist essentially of three

parts. the seed-carrying hopper, the mechanism for selecting the proper quantity of seed and the mechanism for burying the seed in the ground.

PLANT LICE, small soft-bodied insects of the order *Homoptera*. They occur in great numbers, infesting plants both indoors and in the field. The body is somewhat pear-shaped, the legs and antennæ long. Many species have a pair of short tubular cornicles on the abdomen. Mouthparts are fitted for sucking. Some are winged, others wingless. They secrete a sweetish substance, honeydew, from the posterior end of the digestive tube. See **APHIS**.

PLANTS. All living things (organisms) are either plants or animals. While no one would ever be likely to confuse one of the more highly organized plants, such as a fern or an orchid, with one of the more highly organized animals such as a starfish or a horse, it is sometimes difficult, even for a biologist, to decide whether some of the so-called lower organisms are plant or animal. For example, the slime-molds (*Myxomycetes*), low in the scale of life, seem to be on the borderline between the two kingdoms, and have been claimed by both botanists and zoologists. Certain animals, because of an external resemblance to plants (as in the case of those having a stem and branches, such as hydroids and sea-anemones), have been called plant-animals or *zoophytes*. In such instances it is easily seen that the resemblance is superficial, but the calcareous seaweeds (*Lithothamnion* sp.), which secrete an external covering of lime, are reef-builders and have been commonly mistaken for corals, which are animals. In general, there are at least four distinctions between plants and animals, as follows:

PLANTS

1. Possess leaf-green (chlorophyll).
2. Can elaborate organic food.
3. Take in only dissolved or fluid food from the outside.
4. Cell-walls are of cellulose.

ANIMALS

1. Never possess chlorophyll.
2. Cannot elaborate organic food.
3. Take in solid food from the outside.
4. Cell-walls never of cellulose.

But there are some exceptions to these differences. For example, the bacteria and the fungi, which are plants, never possess chlorophyll and therefore cannot elaborate plant food.

Plants and animals are alike in the following characteristics: they are both composed of units of protoplasm called cells; require organic compounds for food; possess irritability, that is, they can detect changes in their environment, and have the power of response when irritated; have the power of motion and some of each class have the power of locomotion; are able to take in material from outside themselves (absorption) and transform it into substance like themselves (assimilation, metabolism); enlarge from within (growth) and not like a snowball by accre-

tion from without; consume oxygen and give off carbon dioxide in respiration; and are able to produce offspring like themselves (reproduction). All of these characteristics, taken together, differentiate living organisms from non-living objects.

THE PLANT BODY

The plant body (like the animal body) is either composed of one cell (unicellular) or of two or more cells (multicellular). All plants are unicellular to start with. In some of the unicellular plants, such as *Pleurococcus*, the cells, after cell-division, tend to adhere for a longer or shorter period. The multicellular condition results from their permanent adhesion.

In the simplest multicellular plants the cells form either superficial or linear aggregates, in the former case adhering side by side to form a flat body or thallus; in the latter case adhering end to end to form a thread-like filament. The term thallus is applied to any plant body not differentiated into root and shoot (stem, branches, and leaves). Such plants are also classified as *non-vascular*, because the distribution of nutrients and elaborated food is accomplished without any system of conducting tubes (vascular system). These plants include the marine, freshwater, and moistland algæ (*Fucus*, *Spirogyra*, *Vaucheria*), the filamentous and fleshy fungi, as bread mold and mushrooms, and mosses and liverworts.

More highly organized plants, such as ferns and seed-bearing plants, require a system of vessels for the distribution of liquids within their bodies and are therefore called *vascular* plants. They possess distinct roots, stems, branches, and leaves. The roots relate the plant to the soil, anchoring it and absorbing water and solutions. The leaves relate the plant to the air and light, absorbing gases and the energy of sunlight. The stem and branches serve chiefly to hold the leaves up favorably into air and light, and to conduct crude sap up through the vessels of the wood and elaborated sap downward from the leaves.

MORPHOLOGY

The study of the form and structure of plants is Morphology, which includes External or Gross Morphology (Organography), Anatomy, and Cytology. Some understanding of cytology is fundamental to the study of anatomy and morphology.

Cytology. In all plants (and animals) the unit of structure, the cell, is a tiny bit of protoplasm, sometimes called the protoplast, organized in two main portions, a *nucleus*, surrounded by a more fluid *cytoplasm* (cell-plasm). In plants the cell is always inclosed in a cell-wall, except in the slime-molds. Protoplasm is not a chemical compound but a mixture of solid particles in suspension (not dissolved) in a liquid, the *cell-sap*, which is permeated with various gases and holds other substances in solution. Such a combination is called by the chemist a *three phase* system. It is also called *colloidal*, from a Greek word meaning glue, because the suspension of tiny particles, not quite as small as molecules and insoluble in the

given liquid, is characteristic of glue. An enormous surface is exposed by these suspended particles, and each of them bears an electrical charge. Moreover, the cell-sap contains various substances in solution; this involves a dissociation of the molecules into their component parts, which also bear charges of positive and negative electricity and are called ions. From this it may correctly be inferred that life is, in reality, an electrical phenomenon.

Anatomy. In unicellular plants the anatomy of the plant and the anatomy of the cell are synonymous. In the thread-like algæ, such as *Spirogyra* or *Vaucheria*, the cylindrical cells all have more or less flat cell-walls at each end, except the end cell, which bulges out at the end because the external pressure is less than the internal. In a cell located between two other cells the external pressure (of the adjacent cells) is practically the same as the internal pressure, hence the end cell-walls do not bulge in either direction. In simple superficial aggregates the pressure of the cells upon each other commonly gives them a hexagonal shape, except that the outer walls of the cells on the outer edge may bulge out. Such interactions of the cells with each other, and with their environment is fundamental to the more complicated details of anatomy, which there is not space here to discuss. As a result of these environmental and intercellular reactions, combined with hereditary factors—in other words, as a product of the combined action of environment, physiology, and inheritance—cells are organized in a variety of *tissues*. To illustrate we may choose the stem of a seedling castor-oil plant. The external layer of cells, one cell thick, is the *epidermis*, which may possess the green coloring substance, chlorophyll. Underneath the epidermis is the *cortex*, several cells in thickness, and bounded on its inner surface by a layer of delicate cells, the *cambium*, which is in a perpetually embryonic condition always capable of cell-division, and by these divisions continually giving rise to new cells on each side of itself. In the center is the pith (*medulla*). At intervals in the cambium cylinder or cone, which is seen as a ring in cross section, somewhat wedge-shaped strands develop. The walls of the strand cells inside the cambium become lignified and constitute woody tissue or *xylem*. The strand tissue outside the cambium is *phloem*. The cells of phloem and xylem become transformed into a system of *bast* fibers, which give strength, and of vessels for the conducting of liquids, and hence these strands are called vascular or *fibro-vascular bundles*. As the stem matures both phloem and xylem tissue develop between the original bundles until each forms a cylinder or cone of phloem and of wood respectively.

Each year the cambium produces at least one new layer of wood at its inner surface and a corresponding new layer of phloem or bast at its outer surface. The cells of each of these layers are larger in the spring and gradually diminish in size toward autumn or with the approach of a condition of drought. Thus the larger cells lie against smaller cells giving the

pearance of rings (annual rings of growth) in cross section. In case of drought or loss of leaves by insects or disease (producing internal drought), followed by a new crop of leaves, two or more relatively thin layers of tissue may form in one year. Leonardo da Vinci discovered that by counting these rings of growth, making allowance for more than one layer in some years, one could tell approximately the age of a tree. Augurs have been invented by which one can bore into a tree and extract a small cylinder of tissue extending from surface to center and thus ascertain the age of the tree without cutting it down or injuring it.

A similar process of tissue formation, with variation as to details, takes place in the root, but throughout the life of the tree the tissue at the tips of both roots and branches continues in the embryonic or undifferentiated condition. These regions are called *growing points*. They may develop at points along the surface, as in the *axils* of the leaves, and thus give rise to branches. The whole series of processes here described varies widely as between different groups of plants. Moreover, each special organ, as leaf, flower, or fruit, has its special anatomy, which may be profoundly affected by external conditions, giving rise to the subject of *Ecological Anatomy*.

Organography. The study of the various organs of the plant, including their external form and condition, their various disguises or variations, and the explanation of the facts observed is External Anatomy or Organography. Correctly to interpret certain organs requires subjecting them or the entire plant to experimental treatment, including external conditions artificially imposed or controlled, such as varying light and heat conditions. Thus, if one cuts off the terminal bud of a tree, like the spruce, one or more of the normally lateral branches next the tip will cease to grow laterally and begin to grow up vertically so as to function as a leader. Certain stems grown in darkness will assume entirely different morphological and anatomical characters than they have when grown in normal light conditions. Such studies come under the head of *Experimental Morphology*. They are on the borderland of ecology and physiology.

PHYSIOLOGY

Plant physiology is the study of the life-processes of plants. In the last analysis all physiology is cellular physiology. Since all function is carried on by means of structures, and all structures are produced by the life-processes of protoplasm, we may regard anatomy and physiology as two different ways of approaching the same problems. Physiological problems may be grouped under four main heads: General physiology, Human physiology, Animal physiology, and Plant physiology.

General physiology deals with the life-processes, such as respiration and digestion, common to both plants and animals (including man).

While the problems of animal physiology naturally group themselves about the various organs, such as

the heart, lungs, or eyes, those of plant physiology naturally group themselves about the relations of the plant to environmental factors, as water, light, air, soil, temperature, and gravity, and the phenomena of growth, movement, and reproduction.

Transpiration. Water is essential to all life, and yet the plant is continually losing it. A large tree in full leaf, such as a maple, may give off several tons of water-vapor on a clear warm day of low humidity. Experiments have shown that the water-vapor passes off chiefly, though not exclusively, through openings (*stomata*) of microscopic size in the epidermis of leaves, stems and other parts. The process is called transpiration. The rate of transpiration depends upon the age and condition of the leaf or other organ, the size of the stomatal openings (which is varied by the movements of the two surrounding *guard-cells*), the humidity of the outside air, the velocity of the wind, and the intensity of light.

Water absorption may be studied under simplest conditions by observing a single cell immersed in tap-water, which, of course, is a dilute solution of various salts. Within the cell is the cell-sap, a comparatively strong solution of sugar and other substances, separated from the outside liquid by the cell-wall and the lining layer of protoplasm, which lies against the inner surface of the cell-wall. Thus the conditions essential for osmosis are realized (*see Osmosis*). The cell-wall and lining layer of protoplasm act as a semi-permeable membrane, allowing some substances to pass but not others. The outer solution, being the weaker or more dilute, passes through the membrane more rapidly than the inner solution passes out. Thus the cell becomes filled to capacity with water which holds the protoplasm closely appressed to the inner surface of the cell-wall. In such a condition the cell is said to be turgid, and turgidity is necessary in order that a cell can perform well most of its functions.

If the outer solution is made stronger than the cell-sap by adding more of the solute (sugar or salts), then the cell-sap passes out more rapidly than the solution passes in through the protoplasm. The solution accumulates between the cell-wall and the lining layer of protoplasm, causing the protoplast to lie more or less free within the cell-cavity. The cell is then said to be plasmolized, that is, the plasma is loosened. In any plant, tree, shrub, or herb, we must conceive of all the healthy cells as turgid. In submerged plants, water, which always means a solution unless we speak of distilled water, may enter through any part or all parts of the surface. The same is true of many algae living on moist surfaces, and of some highly specialized plants such as the Florida moss, a flowering plant which has no roots.

Land plants rooted in the soil absorb practically all their water through their root system. The roots of such a plant are supplied, near the tips, with myriads of tiny, thin-walled *root-hairs*, which are tubular outgrowths of surface cells. They expose a very large surface-area to the soil-water which enters by osmosis, supplying the needs of the root-hairs

themselves, passing by osmosis to adjacent cells of the roots, and finally reaching the vascular system of the wood through which it passes up to all parts. A portion of it, now having been used, passes from the leaves through the stomata, by transpiration, out into the air. The ascent of sap, as it is called, is facilitated by capillarity within the tubes of the vascular system, but the chief force is believed to be the pull upward on the tiny water columns due to the secretion of water from the tissues of the leaves, preparatory to transpiration. This is one of the numerous processes of plant physiology not fully understood.

Photosynthesis. Only green plants can elaborate from inorganic compounds the organic compounds necessary for food. This function is carried on by chlorophyll and chiefly in green leaves. All life, therefore, is absolutely dependent on chlorophyll. Tissue containing chlorophyll is *chlorenchyma*. In the process carbon dioxide is separated into the elements carbon and oxygen, and water into hydrogen and oxygen; these elements are then combined into a carbohydrate, usually a form of sugar. The energy is supplied by sunlight, and the process is, therefore, called photosynthesis, that is, combining by light. The product is called the *photosynthate*.

As the carbon dioxide is used up, its gaseous pressure within the tissues tends to diminish and therefore more passes in from the air through the stomata. The oxygen left over (not combined into sugar) may be partly used in respiration; the remainder diffuses out through the stomata. This exchange of gases during photosynthesis should not be confused with the process itself. Experimental evidence indicates that photosynthesis involves the action of enzymes.

Nutrition. After the photosynthate is formed, part of it, under the action of protoplasm, is transformed into more protoplasm. This is *assimilation*. Since it is a constructive process it is called *anabolism* (building up). The various processes by which new protoplasm is formed and bodily waste repaired comprise *nutrition*.

Photosynthate not used at once is translocated down through the vascular system in the inner bark to storage organs, as seeds, buds, roots, tubers and bulbs, and transformed by enzymes into an insoluble substance, as starch or inulin. Subsequently the storage substances may be digested by other enzymes, translocated (if need be), and used to nourish the plant. The storage organs are the portions used by man for food.

Secretion and Excretion. Protoplasm is continually undergoing chemical changes which result in the formation of organic compounds, such as cellulose for cell-walls, essential oils, gums, resins, and latex, as in *Hevea*, the source of rubber. This process is secretion. In some cases the secreted substances are retained within the tissue or cell, as, for example, the yellow pigment of carrots and of buttercups. When the substance is extruded, as in the gum of spruce trees or the nectar of flowers, the process is *excretion*.

Respiration. All life-processes require energy. The

energy of sunlight has been stored as *potential energy* during photosynthesis, and is made available as *kinetic energy* by the oxidation of living substance. This is accomplished by oxidizing enzymes (oxydases) and is called respiration—a katabolic or tearing down process. Anabolism and katabolism together constitute *metabolism*.

As the oxygen is used up its gaseous pressure within the tissues is thereby diminished and more passes in by diffusion through the stomata and otherwise. This corresponds to breathing in animals, though plants have no special breathing organs that correspond to lungs. Carbon dioxide is formed and given off and the temperature of the tissue is raised. The ratio between the amount of oxygen consumed and carbon dioxide given off is the *respiratory quotient*.

Fermentation. When certain plants are supplied with insufficient or no free air they derive their oxygen from compounds which contain it and are called *anaerobes*. Organisms respiring the free oxygen of the air are *aerobes*. Certain anaerobic organisms, such as yeast and some of the fungi, respire with special vigor under favorable conditions, producing large quantities of carbon dioxide which serves, for example, to lighten or raise dough, or to produce foam in certain beverages. In some cases other substances result (lactic acid in sour milk, alcohol in barley mash). This anaerobic process is *fermentation*, and the various products that result under different conditions are *intermediate products*, due to the fact that the oxidation is arrested owing to an insufficient supply of oxygen. If the process could be carried through to completion the *end products* would be carbon dioxide and water, as in aerobic respiration. The ripening of cheese and sauerkraut, the retting of flax, curing of tobacco and of black tea, and all decay (putrefaction) are processes of fermentation. Life is absolutely dependent upon it. Since aerobic respiration depends upon the action of enzymes it is, in reality, a special case of fermentation.

Growth. As soon as a cell is formed it may begin to take in liquid from without. The resulting internal pressure causes the elastic cell-walls to stretch, and the cell becomes larger. This increase of size is *growth*. Some authors include in the term growth the increase in substance (which is metabolism), and tissue differentiation. To others, including the writer, it seems better to restrict the term growth to designate merely increase in size.

Growth varies with conditions of temperature, light, gravity, water supply, age, and other factors. It also manifests a daily or seasonal periodicity or both, gradually increasing through the given period to a maximum and then gradually diminishing to a minimum, depending upon the peculiarities of the organ or organism and the combination of external conditions. There is also an internal correlation of growth. Thus if the terminal bud of a tree, as the Norfolk Island Pine *Araucaria*, is destroyed, one of the uppermost branches that would normally grow horizontally will begin to turn upward and grow vertically.

Movement. Motion usually results from unequal turgor on opposite sides of an organ. When a stem elongates, one region, parallel to the axis, commonly elongates more rapidly than the tissue on either side of it. This causes the tip to bend over, as in the young leaves of ferns or the "pegs" of bean seeds, which, after being planted, "come up" above the surface of the soil in the form of an arch. By this arrangement the delicate tip is protected while being lifted above the surface of the soil. The region of most rapid growth then shifts to the concave side of the young stem and it straightens up, lifting the young leaves up to air and light.

In elongating roots, stems, leaves, and other parts, the region of most rapid growth passes gradually around the stem to the left (hop) or the right (the common bean), as the case may be, thus causing the tip of the stem to describe a circle or really a spiral due to elongation, to the right (hop) or left (bean). This is *circumnation*.

Tropisms. When an elongating stem is placed horizontally the action of gravity causes the region of most rapid elongation to remain temporarily stationary on the lower side, thus causing the stem to turn and grow up. In elongating roots the stimulus of gravity causes this region to remain stationary on the uppermost side, resulting in the root bending downward. Sensitiveness to the direction of pull of gravity is *geotropism*. Similar effects are produced on elongating stems and roots by unilateral illumination causing some, but not all, stems to bend toward the source of light and some roots to bend away from it. Sensitiveness to the direction of the source of light is *phototropism*. In a similar way we have *hydrotropism*, sensitiveness to water conditions.

REPRODUCTION

The making of new individual organisms may involve only cell-divisions, as when the unicellular *Pleurococcus* or *Bacteria* divide. The dividing cell is the *mother-cell*, the new cells are *daughter-cells*. This is *asexual reproduction*. Or, reproduction may involve the separation from the parent plant of organs or parts of organs, as buds, bulbs, leaves, pieces of root or stem, capable of continuing independent growth. This is *vegetative propagation*, a form of asexual reproduction. All the individuals collectively, produced by vegetative propagation from a single parent, are a *clone*. Thus, all the Concord grapevines in the world constitute a clone, having been derived directly or indirectly by the propagation of vegetative parts of the original Concord grapevine. In reality they constitute only one plant growing on different root-systems in different localities. In a similar way an orchard of Baldwin apples is a clone.

Sometimes, as in yeast and certain bacteria and algæ, the protoplast of the mother-cell organizes itself as a new cell or as a number of small nucleated cells which are finally set free by the dissolving of the mother-cell-wall. These reproductive cells are *spores*, each capable, alone, of developing into a new or-

ganism. Plants that bear spores are *sporophytes*.

More highly organized plants have special organs for spore-formation as *sporangiophores* (blue mold), and *sporangia* or spore-cases (black mold, ferns, and flowering plants).

In some groups of plants, as ferns and clubmosses, all the spores are alike in size and internal organization (homosporous, homospory). In other groups, as the selaginellas and flowering plants, the spores are unlike in size and internal organization (heterosporous, heterospory). The amount of difference in size may vary widely. Thomson in 1931 emphasized the fact that, in some cases, the megaspores of flowering plants are actually smaller than the microspores. The essential difference, however, is not the unequal size but the genetically unequal internal organization. In some plant groups there are two kinds of sporophytes: *microsporophytes*, bearing microspores only, in microsporangia, and *megasporophytes*, bearing megaspores only, in megasporangia.

In practically all groups of plants spores are formed which are unable to develop into new individuals; this can occur only when a spore fuses with another spore. This fusion is a sexual process and is the essence of *sexual reproduction*. Fusing spores are *gametes*. When they are alike in size and other characteristics they are *isogametes*; when they are unlike they are *heterogametes*. The compound cell resulting from their fusion is a *zygote*. This term is applied also to the organism, as a tree, insect, or horse, developing from such a compound cell. The fusion of isogametes is *conjugation*; that of heterogametes, *fertilization*. The larger gamete is often more or less passive and is called the *egg-cell* or egg; the smaller, active gamete is called the *sperm*.

In some of the lower plants, as in the brown seaweeds, the egg-bearing organ is comparatively simple in structure (one-celled) and is called an *oögonium*. In the mosses, ferns and their near relatives, and gymnosperms, as, for example, pines, yews, and cycads, the egg-bearing organ is more highly organized (multicellular) and is called an *archegonium*. From this fact those groups together constitute the *Archegoniates*. The organ that bears sperms is the *antheridium*. Eggs and sperms may both be borne on the same plant, which is then called *monoecious* (of one household), or on different plants which are then called *dioecious*.

Spores give rise only to *gametophytes*, that is, plants that bear gametes but not spores. Thus fern spores develop into a *prothallus*, bearing archegonia and antheridia, but never sporangia. Microspores produce male gametophytes bearing *antheridia* only; megaspores produce female gametophytes bearing archegonia only. Fertilized eggs give rise to sporophytes, plants that bear spores but not gametes. This phenomenon is called the *alternation of generations* and may be diagrammed thus: Spore → gametophyte → gametes → fertilization → zygote → sporophyte.

Plants manifest an almost unlimited number of variations in the morphology, physiology, and ecology

of reproductive organs. The highest form is the flowering plant, the flower being morphologically a branch. The *sepals* of the *calyx* and the *petals* of the *corolla* are homologous to leaves; the *stamens* to microsporophylls, the *pollen-sacs* to microsporangia; the young *pollen-grains* to microspores; the mature pollen-grains to male gametophytes, the *ovules* (in the *ovary*) to megasporangia, bearing megaspores which develop into *embryo-sacs*, each containing an *egg-cell* without cell-walls and several other unwallled cells. The *pistil* (or *pistils*) at the center of the flower is composed of one or more *carpels*, each of which is the homologue of a *megasporeophyll*. The base of the pistil is the *ovary*, commonly prolonged upward as a *style*, at the tip of which is a surface (*stigma*) without epidermis.

When a pollen-grain falls on a stigma it germinates, sending down a *pollen-tube* through the style and into the ovary where it finds an ovule and enters a tiny opening (*micropyle*) in one end. The end of the tube dissolves, possibly by enzyme action, and the sperms pass out. One of them fuses with the egg-cell, which then develops into an embryo-plant, while the ovule develops into a structure that encloses the embryo and the ovary ripens into a fruit. The embryo usually rests for a longer or shorter period. The matured ovule with the contained resting embryo is a *seed*. Plants that bear seeds are *Spermatophytes*. Cycads and pines and their relatives are called *Gymnosperms*, because their seeds are naked, not being inclosed in an ovary. They do not have true flowers. Flowering plants are *Angiosperms*, so named because their seeds are inclosed in an ovary.

ECOLOGY

All the functions of a plant, including the *expression* of its inheritance, are carried on amid a combination of surroundings, the sum total of which is called *environment*. Among the various *factors of environment* are light, temperature, water, gravity, air, soil, other plants, and animals. The plant is, of course, affected by these and must keep favorably adjusted or related to them. They determine the rate at which physiological processes proceed and whether they go on at all, and they modify the anatomical details of the structures involved in the life-processes. The study of plants in relation to the environment is *Ecology*. The ecology of individual plants is *Autecology*, that of plant communities is *Synecology*. See article *Ecology*.

PLANT GEOGRAPHY

Dispersal and Distribution. The term dispersal is used to designate the scattering of seeds and other propagating parts of plants, such as fruits, branches, bulbs, spores, or, as in many oceanic seaweeds, fragments of the plant body. As a result of dispersal, plants have acquired their existing distribution in space, including their grouping into communities or "plant formations" over more or less limited areas, and their geographical distribution over the world.

The reproductive bodies above noted are dispersed

by means of wind, as in winged seeds and fruits; by water, bearing floating parts; insects, carrying about sticky spores, birds distributing indigestible seeds from their alimentary tracts, and also seeds in mud adhering to their feet; mammals bearing about hooked and sticky seeds and fruits adhering to their bodies, and by man in the case of cultivated plants and weeds the seeds of which become mixed with those of cultivated plants.

Reproductive parts are carried to both favorable and unfavorable environments. Whether they survive and propagate the species depends upon whether healthy growth and reproduction can take place in the given environment. Three major factors control: 1. *Soil Conditions*, whether acid, neutral, alkaline, or saline. 2. *Light*. A forest of pine, whose seedlings are *intolerant* of shade, is sometimes succeeded by one of hemlock or of oak, whose seedlings are *tolerant* of shade. 3. *Climate*. Cacti and other *xerophytes* can thrive under desert conditions. Reindeer moss, a lichen, that can withstand arctic cold and drought, illustrates *Arctic* vegetation. There is no vegetation in the Antarctic. Deciduous trees are *mesophytes*, requiring intermediate water conditions. Water lilies illustrate *hydrophytes*; salt-marsh plants are *halophytes*. The distribution of land plants is controlled by various *barriers* to their migration or dissemination. Thus, *island floras* may result when it is not possible for the reproductive parts to be distributed to continental areas over a wide expanse of ocean (salt water). One of the most important barriers is climate, which may produce *zones of vegetation*, either horizontally from the tropics to the polar regions, or vertically from the foot to the summit of high mountains. Horizontal zones only roughly correspond to the geographic zones. On high mountain summits, even in warm climates, alpine and arctic climate and types of vegetation prevail, though temperate or tropical forms occur near the base of the mountain. Vertical zones of climate produce the well-known phenomenon of a *timber line*, above which no trees can grow. Numerous minor controls, such as acid soil, localized desert conditions, absence of proper pollinating insects, excessive wave motion, or too little light because of depth, operate on land and sea. Plants react to climate and other factors by changes of anatomy and external morphology (variation). Darwin called geographic distribution "The almost keystone of evolution."

PALEOBOTANY

The study of the remains of plants of preceding geological ages, preserved by impressions or petrified parts, is fossil botany or PALEOBOTANY. Such studies teach us that geographical distribution was in former ages quite different than now. For example, giant redwoods, now confined to a part of California, were formerly distributed throughout the Northern Hemisphere and in South America, Australia, and New Zealand. Many plants that formerly existed (seed-bearing ferns, *Pteridosperms*) have since ceased to exist, and many plants common to-day (orchids) formerly

did not exist at all. The facts of paleobotany were part of the evidence by which the theory of evolution was confirmed as true, so that evolution is now regarded by scientific men as a fact.

ECONOMIC BOTANY

As noted in the article BOTANY plants were first studied because of their value for food, medicine, and other economic uses. These studies have always continued, and have become elaborated and differentiated into pharmacognosy, medical botany, forestry, silviculture, arboriculture, horticulture, floriculture, agriculture, plant breeding, plant pathology, and other applied sciences, all based upon the pure science of botany. Some of these studies have become so elaborate and so important economically that entire institutions are devoted to their study. Economic botany constitutes a large part of the program of research and teaching in our agricultural colleges and experiment stations. At the University of Wisconsin a large building with staff of investigators is devoted to a forest products laboratory. In England there is the John Innes Horticultural Institution. National societies are organized to promote the study of flowers and vegetables, as the Royal Horticultural Society and various other horticultural societies in Europe and America, or even of one flower or vegetable, as the American Rose Society, Iris Society, Sweet Pea Society, Dahlia Society, and National Carnation Society. Many journals are published to promote interest and knowledge in horticulture, agriculture, or even of a single flower or fruit. The Produce Exchange of New York and similar exchanges elsewhere are organized to promote trading in cereal grains and other seeds, the transactions involved amounting to billions of dollars annually. In fact agriculture, together with its many branches, is the basis of most individual and national wealth, and is the most vitally important human activity.

C. S. G.

BIBLIOGRAPHY.—W. C. Stevens, *Plant Anatomy*, 1907; E. Warming, *Oecology of Plants*, Eng. trans., Groom and Balfour, 1909; F. L. Stevens, *Plant Disease Fungi*, 1925; D. B. Swingle, *A Textbook of Systematic Botany*, 1928; H. N. Ridley, *The Dispersal of Plants Throughout the World*, 1930; A. B. Rendle, *The Classification of Flowering Plants*, 1930; E. C. Miller, *Plant Physiology*, 1931; A. M. Johnson, *Taxonomy of the Flowering Plants*, 1931; C. S. Gager, *The Plant World*, 1931; Kerner and Oliver, *The Natural History of Plants*, n.d.

PLANTS, CULTIVATED. See CULTIVATED PLANTS. See also the articles AGRICULTURE; BEVERAGE PLANTS; CEREALS; CITROUS FRUITS; FIBER PLANTS; FLORICULTURE; FORAGE PLANTS; GRASSES; HORTICULTURE; MEDICINAL PLANTS; ROOT CROPS; VEGETABLES.

PLAQUEMINE, a city in southern Louisiana, the parish seat of Iberville Parish, situated on the Mississippi River, 15 mi. south of Baton Rouge. The Texas and Pacific and the Missouri and Pacific railroads serve the city. The Intercoastal Canal, known as the Bayou Plaquemine, is connected with the Mississippi by Government locks and is navigable to Lake Charles, La., and Houston, Tex. Plaquemine is a shipping center for cotton, sugar, rice, oil and lumber

and for various manufactures, including lumber products, veneer and cooperage. The first town lots were sold in 1819. Pop. 1920, 4,632; 1930, 5,124.

PLASKETT, JOHN STANLEY (1865-), Canadian astronomer was born at Woodstock, Ontario, Nov. 17, 1865. He was educated at Toronto University, taught there from 1890 to 1903 and then entered the Astronomical Branch of the Dominion Department of the Interior. In 1903 he became the Astronomer of the Dominion Observatory at Ottawa. He began in 1914 the organization of the Dominion Astrophysical Observatory at Victoria, B.C., and in 1918 completed the work. He published many papers on spectroscopic observations and the design of spectroscopes and telescopes.

PLASSMAN, THOMAS (1879-), American educator and priest, was born in Avenwedde, Westphalia, Germany, Mar. 19, 1879 and came to the United States in 1894. In his studies at St. Francis Solanus College, Quincy, Ill., and at Rome, Louvain and Bonn, he specialized in theology and Oriental languages and in 1906 was ordained a Roman Catholic priest. In 1910 Plassman became associated with St. Bonaventure's College, where in 1920 he was elected president of the high school, college and ecclesiastical seminary. He is the author of *The Signification of Beraka*, 1913.

PLASTER CASTING, in sculpture, a plaster copy of a clay model or the act of casting a plaster copy. There are three types of mold: the waste mold, piece mold, and gelatine mold. In the waste mold process the clay model is divided by pressing thin strips of metal into the clay to form a separating wall so that the mold can be separated into two parts. A tinted layer of plaster of Paris about one one-quarter of an inch thick is applied to the whole model. If the model has undercuts, such as drapery, etc., these are coated with a thin mixture of clay and water, after which the whole model is covered with a thick layer of plaster. If necessary, iron rods and burlap are used on the outside to strengthen it. The mold is then separated and the original clay model dug out. The mold is thoroughly washed and treated with a lather of green soap, wiped off and oiled with olive oil. Plaster is laid in both side of the mold and the mold put together. The seams are filled with plaster, burlap mixed with liquid plaster is laid in, and more plaster is added to give the desired thickness. When this is set, the plaster mold is chipped away with a blunt chisel. The inner tinted surface serves as a warning to the operator that he must be very careful and not injure the cast which he has now reached. This process is used only in casting from a moist clay or plastelene model. Both the original model and the mold are destroyed in the process, which explains the term waste mold.

The making of a piece mold is a very complicated process and is used in order to make reproductions of finished marbles and bronzes. It is a much more thorough method than the glue mold. This mold is made in small sections so that each one can be with-

drawn from the model and fitted together again, making a complete mold. The statue is placed on its back if possible as only one-half of the mold is made at a time. It is well oiled, and instead of a separating wall of thin metal, a bearing of clay is made. Each small piece is made separately and has to be well soaped and greased so there will be no sticking. Little wire hooks are placed in each piece so the pieces can be tied together with string. A shell of plaster, reinforced with burlap and iron, is made to cover and hold the pieces of the mold. All are soaped and oiled thoroughly, and after the plaster cast has set inside are removed carefully, one by one, soaped and oiled again and replaced ready for another casting. This method is also used in the making of terra cotta figures for firing.

The gelatine process or glue mold is also used when more than one copy is desired from the same model. This process is extensively used for commercial casting. The surface of the model is first carefully varnished and covered with a thin layer of paper. A layer of clay three-quarters of an inch thick is then applied, which is in turn covered with an outer shell of plaster strengthened with scrim and wood or iron if the size of the casting so demands. The layer of clay is then removed and the plaster cast is shellaced and oiled and placed over the model. Hot gelatine or glue is poured into the space left by the clay layer. When the gelatine has hardened it is treated with alum water and chalk and left for several hours before it is used for castings. W. Z.

PLASTER OF PARIS. See GYPSUM PLASTER.

PLASTER WORK. Plaster is used as finish for walls and ceilings and, as *Stucco*, is applied to the outside surfaces of walls. Plaster for interior work may be divided into. *Lime Plaster*, ordinarily applied in three layers or "coats": "scratch," "brown" and "finish." Although a good non-conductor of heat, lime plaster begins to spall and fall off under the action of heat and is a poor fire resisting material; *Cement Plaster*, consisting of cement and sand is applied in two or three coats, depending upon the thickness required, and is a semi-fireproof material.

PLASTICS. There are a number of different materials, natural and synthetic, that may be fabricated in a plastic state. Among them are potter's clay, mortar, and Portland cement, each made plastic by wetting; also, glass, wrought iron, rubber, casein products, bituminous products, shellac compounds, cellulose ester products and synthetic resin products, made plastic by heating.

The term *plastics* in common usage, however, tends to be limited in its application to a group of materials, organic and largely synthetic, which are made plastic by the use of heat and are capable of being molded or pressed directly and rather expeditiously into more or less finished forms. These materials lend themselves to the mass production of duplicate parts. Important are the following:

Shellac, used in the material of phonograph records.

Bituminous products, which find general use in the

material of storage battery jars, and in so-called cold molding plastics, long used for electrical insulation.

Cellulose plastics, chief of which are the pyroxylin, or nitrated cellulose, products. Pyroxylin, plasticized with camphor, was introduced by Hyatt, in 1870, under the trade name CELLULOID. Large quantities are employed for toilet articles, pen barrels, etc., and as the middle layer of shatter-proof glass. Pyroxylin products are tough and flexible. CELLULOSE ACETATE products, which have lower inflammability, are of growing importance.

Casein plastics, best known under the trade name Galalith. These are essentially milk curd hardened with formaldehyde. They are characterized by toughness and good color effects.

Synthetic resin plastics, most important of which are the products introduced by Baekeland in 1909 under the trade name Bakelite. In their simplest form they are produced by the union of PHENOL and formaldehyde. They brought a new and important characteristic to the plastics arts; namely, that of hardening with heat. In addition, the final hardened product is a good electrical insulator, and is strong and enduring. It is extensively employed, in molded and laminated forms, in the electrical, mechanical and structural arts.

Of increasing importance are the heat-hardening, ureaformaldehyde products. They are best known for their light color effects in the molding of tableware marketed under the trade name Beetle. The vinyl and styrol resin plastics, also light in color, are finding use where resistance to heat is not important.

RUBBER is ordinarily not included in the discussion of the modern plastics industry. This product presents somewhat different problems of fabrication and has characteristics of its own. In addition, the wide use of rubber in the manufacture of commodities tends to accord it separate consideration.

L. V. R.

PLATA, RIO DE LA, a large estuary, also known as the River Plate, which is formed by the Paraná and Uruguay rivers and lies between Uruguay and Argentina, South America. The estuary is about 160 mi. long. Montevideo and Buenos Aires are located upon it. Rio de la Plata means Silver River.

PLATAEA, BATTLE OF, the famous battle fought in 479 B.C. against the Persians led by Mardonius at Plataea, an ancient Greek city of Boeotia near Thebes. The Peloponnesian Greeks were commanded by the Spartan Pausanias, and through his skillful leadership, ably assisted by the Spartan and Athenian contingents, the Persian army was completely shattered and disintegrated. The inhabitants of Plataea celebrated their victorious campaign annually thereafter, and capped their annual festivals with an *Eleutheria* or Festival of Liberation every fourth year.

PLATEAU, JOSEPH ANTOINE FERDINAND (1801-83), Belgian physicist, was born at Brussels, Oct. 14, 1801. He was educated at Liège and was professor of physics and astronomy at the University of Ghent from 1835 to 1871. His researches were chiefly devoted to optics, molecular ten-

sion and mineral surfaces. In 1840, after conducting an experiment in which he looked directly at the sun for some time, he became blind. He died at Ghent, Sept. 15, 1883.

PLATEAU, an elevated plain, or tableland. Plateaus are great blocks of the earth's crust which have shared in the uplift of adjacent mountain regions, without suffering much disturbance of their strata. The so-called Great Plains of the western United States constitute a vast plateau sloping from the Mississippi to an elevation of 4,000 ft. at the base of the Rocky Mountains. To a large extent this great plateau has been built up by accumulations of debris eroded from the Rocky Mountains. The Colorado plateau, lying between the Rockies and the Sierra Nevadas, is still higher, while that of Tibet, flanked by the Himalayas, rises to an elevation of 10,000 to 13,000 ft.

Plateau topography is essentially rugged, especially in dry regions where it is marked by deep canyons, and outstanding table-hills called **MESAS** and **BUTTES**. The climate of high plains is usually cool, and often

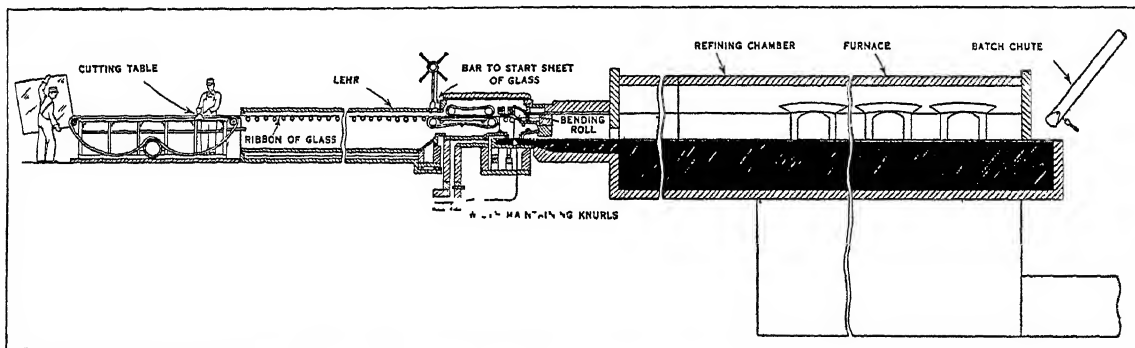
Plate glass may be reenforced by imbedding single wires or wire mesh; also by cementing plates together with transparent plastics. See **SAFETY GLASS**. A. S.

BIBLIOGRAPHY—F W Hodkin and A Cousen, *Text-book of Glass Technology*, 1925.

PLATEN-HALLERMUND, AUGUST, GRAF VON (1796-1835), German poet, was born at Ansbach, Oct. 24, 1796. He was a devotee of exotic forms of verse. Goethe commended his *Ghaselen*, or *Ghazals*, 1821. These were, however, jeered at by Heinrich Heine and Karl Immerman, and a protracted series of literary mud-slinging efforts resulted. Platen's verse has genuine poetic qualities, and his Venetian sonnets are unequalled in the German language. He wrote several dramas, and toward the end of his life was fascinated by ancient meters without rhymes. He died at Syracuse, Sicily, Dec. 5, 1835.

PLATINITE. See **NICKEL STEEL**.

PLATINUM, a heavy steel-gray chemical element, the best known representative of the group of platinum metals, has been known since the 16th century, al-



COURTESY LIBBEY OWENS GLASS CO

SCHEMATIC DIAGRAM SHOWING STEPS IN THE MANUFACTURE OF PLATE GLASS, FROM RAW MATERIALS TO FINISHED PRODUCT

arid, because rain-bearing winds are intercepted by neighboring mountains. A dissected plateau in a humid region may result in the formation of "pseudo-mountains," like the Catskills, in New York.

PLATE GLASS was invented in 1688 at Saint Gobain, France, by Lucas de Nehou. The process consisted of casting glass on a steel table, and passing a roller over the glass. After annealing, the rough surface was ground with an abrasive and water, and subsequently polished with wet rouge.

In recent years, the Bichroux process has been utilized to a considerable extent. In this the glass is cast between rolls, from the pot, and travels on an inclined table to a horizontal position. Sometimes, the plates are cut lengthwise as they go along the table.

Another of the recent developments is that of the Ford Motor Company in Detroit, where the glass is melted in tank furnaces and flows continuously between rolls. In all of the processes mentioned, annealing, grinding and polishing are a part.

The thickness of plate glass depends, in the old process, on the height of tracks; in the newer process it depends on the distance between rolls. Subsequent grinding will reduce this thickness somewhat.

though actually an alloy containing platinum has been found in a tomb in Egypt, dating from 700 B.C. At one time used as an adulterant for gold in coins, the price has now risen considerably above that of gold. The present supply is largely derived from the Ural and Colombia. The chemical symbol is Pt, the atomic weight 195.23, while in the pure state the metal has a specific gravity of 21.4 and a melting point of 1755° C; it is easily malleable and ductile, and too soft to be used alone. Alloyed with small quantities of iridium it becomes hard and is used extensively for electrodes, for all kinds of laboratory apparatus, for surgical instruments, and in jewelry. Finely divided platinum is an excellent catalyst for many chemical reactions, but is not so much used any more industrially as iron and chromium oxides, though less efficient have been found more economical.

PLATO (427-347 B.C.), Greek philosopher, was born at Athens in 427 B.C. He was the son of Ariston and was descended from a noble family. **SOLO**n, the Greek lawgiver, was one of his ancestors. His real name was Aristocles; but he took the name Plato because of his unusual size. Plato's long life of 80 years may be divided into two equal periods,

the first comprising his education and travels and the second his life's work as teacher at the Academy. Early introduced to the philosophy of Heraclitus by Cratylus, he later became a pupil of SOCRATES. Upon the death of Socrates in 399 Plato spent 12 years in travel. At Megara he became familiar with Parmenidea and later with the Pythagorean number philosophy. While in Sicily he became acquainted with DIONYSIUS THE ELDER, who gave him a chance to try out his ideal republic. Failing in this he lost his liberty for a time. Returning to Athens in 387, Plato founded the Academy where he taught with but few interruptions for a period of 40 years. He died in Athens in 347 B.C.

Philosophy and Writings. Plato's works have been preserved in the *Dialogues*, philosophical writings matchless for simplicity and beauty of expression. In fact Plato sometimes allows his artistic nature to get the better of him so that it is difficult to distinguish mythological lore and poetic license from actual philosophical teachings. In these discussions Plato makes Socrates play the leading rôle for the most part. Nevertheless the *Dialogues* are usually divided into the more Socratic and the more strictly Platonic. In the former Plato is portraying the life and teachings of Socrates, while in the latter he develops his own theories. A middle group is sometimes called the sophistic polemics, the author attempting to refute the teachings of the sophists. To the first group belong the *Phaedo*, the *Meno*, the *Crito* and the *Apology*; to the second the *Symposium*, the *Timaeus*, the *Parmenides*, the *Republic* and the *Laws*; and to the third the *Phaedrus*, the *Protagoras*, the *Gorgias* and the *Theaetetus*. The *Parmenides*, in which Plato criticizes his own doctrine of ideas, is sometimes not attributed to him. The *Republic*, in which he considers the nature of justice in an ideal state, is his masterpiece.

The Theory of Ideas. To Plato ideas are more real than things. But these ideas are not essentially psychological in character; they are metaphysical entities of the nature of subsistents. They are archetypal forms, perfect patterns from which particular things are drawn. Particulars imitate the ideas. Knowledge of these ideas is gained by a kind of mystical insight, an intuition of reason that in its perfect form is reserved for philosophers alone. Yet even for philosophers it presupposes a preexistence, for all cognition is recognition, i.e., re-cognition. From this Plato was able to argue to a postexistence. Although the ideas were infinite in number, Plato had a decided preference for those of worth. Goodness and beauty were to him synonymous. All ideas tend to realize the good. The ideas are arranged in a hierarchical order with the idea of good at the top. From merely participating in reality, particulars tend more and more to realize their kind, and all to realize the good.

The Ideal State. Justice in the ideal state consists of each doing that for which he is best fitted by nature to do. Injustice arises when people begin to meddle in each other's business and to do things

for which they have not the ability. The philosophers should rule, the warriors protect, and the artisans work. These constitute the main classes of society. To each is given a training suitable to his needs, special emphasis being given to music for the soul and gymnastics for the body. To the philosopher kings are given the greatest amount of education. In the life of an individual justice is a harmony of the virtues; so is it in society. See CARDINAL VIRTUES.

Influence and Estimate. By his liking for a world of permanent and perfect forms in preference to a world of sense and change, Plato put the emphasis upon another world rather than this world of experience. His world of ideas became identified with the other world for Christianity, a world somehow more important and better than this earthly lot. The metaphysical validity he gave to concepts sent thought astray in search of eternal essences. Absorbed in this pursuit, it quite lost sight of its instrumental function in shaping the world of change more to our liking. Although Plato would use scientific means for determining an individual's position in society, his classes are narrow and somewhat rigid.

R. N. B.

PLATONOV, SERGEIEFF (1860-), Russian historian, was born in Chernigov, in 1860, the grandson of a serf. After his appointment as professor of history 1890, at the University of St. Petersburg he became tutor to the Grand Duke and Duchess 1895-1900. After the Revolution he acted as archivist on various commissions.

Platonov is generally acknowledged as the greatest of modern Russian historians. His works include *Boris Godunov*, *Ivan the Terrible*, *Colonization of Russia*, *Times of Trouble*.

PLATOON, a unit composed basically of a headquarters and two or more subunits, ordinarily sections, but sometimes squads. The exact constitution varies with the type of unit and is announced from time to time in the tables of organization published by the War Department. The next superior unit to a platoon is a COMPANY, troop or battery. A platoon is usually the command of a lieutenant.

PLATT, THOMAS COLLIER (1833-1910), American legislator, was born at Owego, Tioga Co., N.Y., July 15, 1833. He entered Yale in 1849 but left the following year to devote himself to trade, and was made president of the Tioga National Bank in 1865. As a supporter of Roscoe Conkling, he rose to political power, and in 1873-77 served in Congress as a Republican. In January, 1881, he was elected to the U.S. Senate, but resigned, together with his colleague, Roscoe Conkling, after serving only a few months, because of a disagreement with President Garfield over governmental appointments in New York. He failed to gain reelection to succeed himself, but in 1896 he was again elected to the U.S. Senate, serving for two terms (1896-1909). Platt was for a long time "boss" of the Republican machine in his state, and it was largely through his efforts that Roosevelt was nominated, and subsequently elected vice-President

of the United States. He was a delegate to every Republican National Convention from 1874 to 1904. Platt died at New York City, Mar. 6, 1910. A. D.

PLATT AMENDMENT, a statement of the restrictions placed by the United States upon the autonomy of Cuba. After the Spanish officials had withdrawn from Cuba, pursuant to the TREATY OF PARIS, 1898, a constitutional convention of Cubans adopted a constitution ignoring the subject of future relations with the United States. An amendment framed by United States Senators Platt and Spooner, attached to an army appropriations bill of Mar. 2, 1901, listed eight provisions to be adopted by the Cuban Government before the United States should withdraw its military government from the island: in part, that the United States should have the right to intervene for the protection of "life, property, and individual liberty;" that the Cuban Government make no treaties with foreign powers impairing its independence; that the Cuban Government should execute the American projects for the sanitation of the cities of the island; that the United States should acquire lands in Cuba for coaling or naval stations. The Platt Amendment was adopted, June 12, 1901, as an appendix to the Cuban constitution.

PLATTE RIVER, the chief river of Nebraska, formed by two branches, the North Platte and South Platte. The former rises in North Park, Colo., swings north and east through Wyoming into Nebraska where, after a 510-mi. course, it joins the south branch at the city of North Platte. The South Platte rises in South Park, Colo., and flows generally northeast for 427 mi. before the two branches meet. The trunk stream flows eastward for 315 mi. and empties into the Missouri a little below Omaha. Within the mountains the branches have an extremely steep and irregular slope which, upon reaching the plains, diminishes to 8 or 9 ft. per mi. Below their junction the Platte maintains an average fall of about 6 ft. per mi. In spite of this relatively steep slope and an unusually straight course, the river is building up its bed due to its being overloaded with silt. It fluctuates greatly in volume, being 1 mi. wide in the spring and at other times almost dry. The depth of its channel is insufficient for navigation. The Overland Trail, the great emigrant highway to the west, followed the Platte River and is now paralleled by the Union Pacific railroad.

PLATT NATIONAL PARK, an 848.31 acre tract in Murray Co., south central Oklahoma. It was established July 1, 1902 and is under the administration of the National Park Service of the Department of the Interior. The park is attractively situated in high country with a delightful climate. Sulphur and other springs, both hot and cold, whose waters have beneficial properties, gush forth plentifully throughout the region. The park is reached from Sulphur on the Atchison, Topeka, and Santa Fé railroad and by automobile from Ardmore on the Lee Highway.

PLATTSBURG, a city in northern New York, the county seat of Clinton Co., situated on Lake

Champlain and the State Barge Canal at the mouth of the Saranac River, 168 mi. northeast of Albany. Lake steamers, bus lines and the Delaware and Hudson Railroad serve the city. The Plattsburg-Mobodo Airport is here. The region is farming and dairying country. Lumber and paper products are manufactured. In 1929 the industrial output was approximately \$4,000,000; the retail trade amounted to \$10,207,068. The city has a new State Normal School. During the World War 29,000 reserve officers were trained at Plattsburg Barracks near by, and every summer since 1920 the Citizens Military Training Camp has been in session here. Cliff Haven, in the neighborhood, is the seat of the Catholic Summer School of America.

The first settlers of Plattsburg came under the leadership of Zephaniah Platt. The village was incorporated in 1795; the city chartered in 1902. The first naval battle of the American Revolution, a British victory, took place off Valcour Island, near by, in 1776. The American forces on the northern frontier were quartered here during the War of 1812. The Macdonough Monument commemorates Commodore Thomas Macdonough's victory over the British (Sept. 11, 1814). Plattsburg is a winter sports center and summer resort, situated in view of the Green Mountains across the lake, with the Adirondacks in the distance on the south. Ausable Chasm is in the vicinity. Pop. 1920, 10,909; 1930, 13,349.

PLATTSBURG, BATTLE OF, Sept. 5-11, 1814, an engagement of the WAR OF 1812. As part of the joint campaign of British land and naval forces to control Lake Champlain and so open the way for invasion of the Hudson valley, 14,000 troops under Sir George Prevost advanced against Plattsburg, occupied by Gen. Macomb with 700 men. Macomb sent out skirmishing parties which harassed the British, Sept. 5-6, with a loss of over 200 British and about 45 American troops. Prevost was employed, Sept. 7-11, in bringing up battering trains and in erecting works to command the defenses of Plattsburg. On the 11th the naval forces fought the BATTLE OF LAKE CHAMPLAIN. By prearrangement the British batteries opened upon Plattsburg as the naval battle began; Macomb's army, reinforced by militia, repulsed the enemy at each of the three points assailed. The battle was interrupted by news of the surrender of the British fleet; Prevost on the 12th ordered a general retreat into Canada. The British loss, mostly deserters, was almost 2,000; the American loss was about 110.

PLAUEN, one of the most important industrial cities in the German state of Saxony, located on the White Elster River about 42 mi. southwest of Chemnitz. In 1925, 56.2% of the total population and 44.2% of the female citizens were engaged in remunerative work. The textile industry, with its various branches, is predominant, and the city has textile schools. There is a thriving trade in yarn and livestock. Plauen was mentioned first in 1222 and became a city 1244. Pop. 1925, 111,436.

PLAUTUS, TITUS MACCIUS (c. 254-184 B.C.), one of the greatest Roman writers of comic drama, was born at Sarsina, in Umbria, probably in 254 B.C. From the first, as a youth in Rome, he mingled with actors and studied the models of Latin and Greek literature; but various efforts to earn his living, including even the occupation of turning a hand-mill for a baker, delayed his success as a writer of comedies in verse until he was about 30. In the next 40 years, however, he continued to produce so rapidly that he has been credited with 130 plays. Of these, there survive only 21, not all complete. Although Plautus was indebted to the Greeks, particularly MENANDER, for his plots, he handled them with refreshing originality, and his lively wit and clever dialogue, enhanced by the perfection of his Latin verse, gave him a wide and lasting fame. Shakespeare and Molière were indebted to him. Among Plautus's plays are *Asinaria*, *Aulularia*, *Bacchides*, *Casina*, *Curculio*, *Miles Gloriosus*, *Captivi*, *Truculentus*, *Vidularia*. He died in 184 B.C.

PLAY, a dramatic composition for stage representation by actors, classified under such divisions as TRAGEDY, COMEDY, FARCE, BURLESQUE, MELODRAMA, etc. See also DRAMA; CHRISTMAS PLAYS; CHRONICLE PLAY; MORALITIES; MYSTERY PLAYS; PLAYWRIGHTING; PROBLEM PLAY.

PLAY, PSYCHOLOGY OF. Play is activity for its own sake. Spencer regarded play as an expression of surplus energy; this is one of the popular notions about it as may be seen in the philosophy that children must play in order to get rid of their surplus energy.

Groos attaches some practical significance to the phenomenon of play. He regards it as sort of a dramatic rehearsal for later experiences of life. The child at play is quite unconsciously practicing for life's serious activities. In art the dramatic rehearsal is at its best, and undoubtedly there is a large play element involved in acting for the theater.

In play there is a divorcement between the means and ends of action; or, viewed from another angle, they are one. There is separation because the end is not considered at all and there is union because means and end are one, the end being absorbed in the means and not consciously recognized. Interest is located in the action itself. Hence the activity of play needs no further justification. Play is enjoyable because this interest is immediate. The mere exercise of the functions necessary for carrying on the activities involved in play produces pleasure, for pleasure is an accompaniment of such activity.

Much attention has been given to the play impulse by modern pedagogy. By directing the play activities of the child his interest can be guided into fruitful activities without his awareness of it. Play becomes a powerful incentive that may issue into valuable consequences from the standpoint of learning. The game has been widely used as one of the best devices for introducing the play element into the work of the school. When rivalry and competition are in-

troduced into the games these often take on an added excitement.

BIBLIOGRAPHY.—J. Dewey, *Democracy and Education* (1916); F. Bobbitt, *The Curriculum* (1918).

PLAYGROUNDS, a play area with play leaders and varied interesting and optional activities. There are neighborhood playgrounds primarily for children of school age and neighborhood playfields primarily for youth and adults, with facilities for games and sports and a field house or community center for indoor recreational activities. Playgrounds are commonly provided with apparatus, the most usual being sand boxes, swings, slides, teeters; with play areas for various games, such as playground baseball, volleyball, basketball, and for free play; and with shelter houses. Many are attractively landscaped.

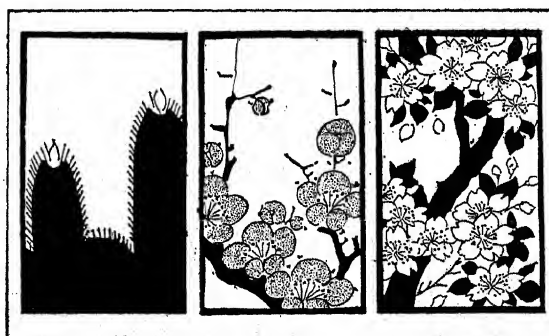
Playgrounds were opened in Boston about 1887. In 1920, 2,632 playgrounds were reported, in 1930, 7,677 playgrounds in 766 cities in the United States and Canada. Their programs include games, sports, athletics, handicrafts, musical and dramatic activities, folk dancing, story-telling and nature lore.

Playgrounds have an important influence on reduction of street accidents to children; on health, through outdoor activities; on JUVENILE DELINQUENCY; on development of sportsmanship and team play; they offer opportunity for exploratory experiences and development of elementary skills in various activities; and provide fun and happiness.

Beginning as a philanthropy for poor children, playgrounds are now maintained as a service for all through tax support and public management, chiefly through recreation, park or education departments.

R. S. W.

PLAYING CARDS, in the present-day sense, consist of a pack of 52 oblong slips of cardboard, divided into four suits of 13 cards each, namely spades, hearts,



COURTESY UNITED STATES PLAYING CARDS CO.

JAPANESE FLOWER GAME: FIRST THREE MONTHS

The Flower Game is the calendar of Old Japan. There are four cards for each of the twelve months. Shown here are the first month, the pine; the second month, the plum blossom; and the third month, the cherry blossom. The first two cards in each month count one apiece; the third, showing a "Tanjaku," or little verse, counts five; and the fourth, bearing the emblem of the flower festival for its month, counts ten and sometimes twenty.

clubs and diamonds. They are used in a variety of games, of which an outstanding few are BRIDGE, POKER, EUCHRE, WHIST, PINOCHLE and SOLITAIRE. The peculiar historical interest attached to cards lies in

the variety of picturesque designs imposed on them by artists during the last eight centuries. In a restricted sense, the story of playing cards since 1120, about the year of the earliest specimens preserved to-day, is the romance of a long progression of



COURTESY UNITED STATES PLAYING CARDS CO.

THE POPE: ONE OF THE PLAYING CARDS
PRINTED FOR CHARLES VI OF FRANCE
IN 1392

painters, illustrators, workers in woodblocks, engravers and printers, whose designs reflect the fashions in vogue at different courts, the weapons used in warfare, and other colorful and realistic aspects of life in their times. But unquestionably the history of playing cards long antedates the later Middle Ages.



COURTESY UNITED STATES PLAYING CARDS CO.

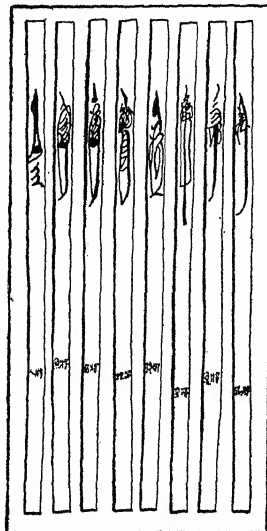
HINDU PLAYING CARDS

The deck has ten suits picturing the ten avatars, or incarnations, of Vishnu. One of the numerals and court cards of the third incarnation, Varahavatara the Boar, is shown. The body is blue, but not the head. He holds the Chakra (metal circle), and wears the jewel on his breast.

Origin. The researches of Stewart Culin of the Brooklyn Museum definitely give the origin of cards to China, the birthplace of the preponderance of games of chance. He asserts that "playing cards were introduced into Europe from China, and were spread

quickly from Europe over the civilized world." In partial support of this assertion there exists an account in a Chinese dictionary, the Ching-tsze-tung, of 1678, telling of card playing among the concubines of Seun-ho. Less recent authorities have traced the invention of playing cards to India and again to Egypt. The invention in 1440 of printing from movable type accelerated the spread of card games, but even during the Renaissance many packs of playing cards continued to be designed and colored by hand. In the late 15th century Germany enjoyed flourishing trade in card printing, and the Germans gave a direction to card design which is still apparent. The queens are seated upon magnificent thrones; the king is mounted and carries a banner, and the knave, or jack-a-napes, was represented as a valet to the king. The English, returning home from Continental wars of the late 15th century, were quick to add their peculiar characteristics to cards. They provided the queen with lappets over her ears, a style in vogue during the reign of Henry VII. The knave, or jack, wore a flat cap, "broade on the crowne like the battlements of a house."

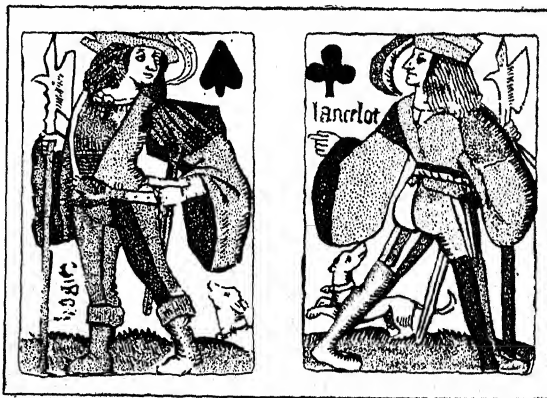
In making playing cards of this and later days, all nations followed the lead of Germany in designating



COURTESY UNITED STATES PLAYING CARDS CO.

KOREAN PLAYING CARDS

Some authorities believe the Korean cards were the earliest in existence. There are ten cards to each of the eight suits, each a narrow strip of oiled paper.



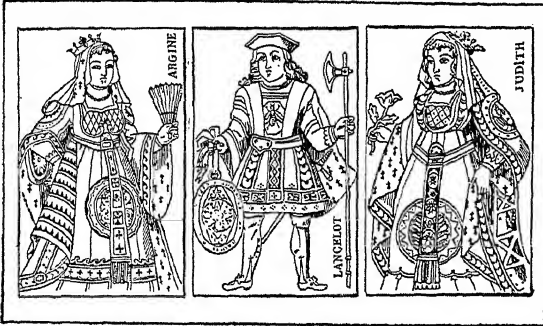
COURTESY UNITED STATES PLAYING CARDS CO.

THE EARLIEST PLAYING CARDS MADE IN EUROPE

Printed from wood blocks made in the old province of Provence, Southern France, about 1440

the suits by hearts, bells, leaves and acorns. Such designation, however, was generally executed with very reduced suit symbols in the upper right-hand corner, so that most of the space was left for decora-

tion. Such decoration might consist of historical scenes, often sensational and morbid; a succession of such scenes, with appropriate captions, sometimes in verse; animals; peasants; bars of music; maps of European countries, or a complete condensed history of a nation, thus permitting the player to add to his knowl-



COURTESY UNITED STATES PLAYING CARDS CO.

FRENCH COURT PLAYING CARDS OF 1813

Designed at Napoleon's command in 1811 by the painter, Jacques Louis David

edge while waiting for a hesitant opponent to deliberate which card to play. The makers of one such set in 1790 thoughtfully printed a tabloid geography of "Asia under Spades, Africa under Clubs, Europe under Hearts, and America under Diamonds."



COURTESY UNITED STATES PLAYING CARDS CO.

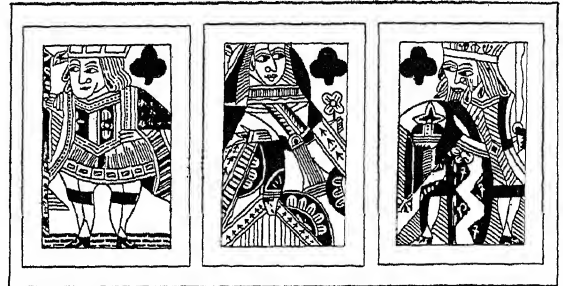
THE QUEEN OF CUPS AND THE KING OF BATONS

Court cards from a pack of Italian tarots of the early 18th century. Tarots were cards with gridded or checkered backs, 78 to a pack, 22 of which were tarots (trumps)

Introduction Into America. Playing cards were introduced to America by the Spaniards. In the 17th century they were anathematized in New England by the Puritans, and second offenders were "publicly whipt." In the South, however, their use spread. After 1776, playing cards in this country began to mirror United States history, after the manner of European cards. On the plain side, Paul Revere's eagle was frequently impressed, and in some packs

the aces were richly embellished with stars and stripes. A spade ace in a pack of 1850 bears portraits of George and Martha Washington. During the Civil War, Confederates' playing cards were embossed with the flags of the South, while Union packs bore likenesses of Grant and Sherman.

The mechanical era was heralded on cards by designs of steamboats, locomotives, bicycles and airplanes, while the portraits of actresses and baseball



COURTESY UNITED STATES PLAYING CARDS CO.

THE FIRST AMERICAN COURT CARDS, PRINTED ABOUT 1800

From the playing card manufactory of Jazaniah Ford of Milton, Massachusetts

favorites were also passing fads. Since 1924 the angle and plane motifs of modern art have been conveyed in a variety of adaptations to the backs of cards. Round playing cards, which first appeared in this country in 1874, have enjoyed a slight modern vogue. The mounting interest in bridge and other card games led card manufacturers in 1930 to offer large-sized cards made of aluminum and tile for outdoor play on beach or lawn. While cumbersome to shuffle, their weight makes card play possible in the face of a breeze.

See Catherine Perry Hargrave, *History of Playing Cards*, 1930.

PLAYWRIGHTING. Like other arts, playwrighting has passed repeatedly through a four-fold cycle. Eras of innovation have led to ages of codification of "laws" based on the more successful experiments. There have ensued periods of more or less docile imitation, accompanied by an over-growth of conventions, leading naturally to final phases of revolt. Academic influences have sanctified past precedents; an undying spirit of progress has encouraged departures from tradition.

There has been a general movement from beauty of phrase, rising sometimes into the noblest poetry, toward reproduction of everyday speech; from theoretically approved externals toward psychologically approved internals; from emphasis on situation and its attendant improbabilities toward emphasis on character and its consequent truth. Classic TRAGEDY abounded in quotable speeches, adhered closely to forms previously or subsequently hallowed by theorists, and did not hesitate to mix real and unreal without abandoning moods made hospitable to such contradictions only by broad conventions. Classic COMEDY, nearer to life, more sensitive to popular reaction, and always ready to ridicule the preciousness into which the more dignified forms so frequently lapsed, led to a

greater mastery of playwriting. Technical development which, in Greece, may be epitomized by the names of ÆSCHYLUS (525-456 B.C.), SOPHOCLES (497-405 B.C.), EURIPIDES (480-405 B.C.) and ARISTOPHANES (444-380 B.C.), was later paralleled in Rome by the advance from ENNIUS (240-169 B.C.) to PLAUTUS (250-184 B.C.) and his more fastidious imitator, TERENCE (194-159 B.C.).

After the long hiatus of the Dark Ages a similar evolution in Spain culminated in LOPE DE VEGA (1562-1635), imitated by CALDERÓN (1600-81), and in France led from the austere classicism of PIERRE CORNEILLE (1606-84) and RACINE (1639-99) to the comic masterpieces of MOLIÈRE (1622-73). In England, dramatic technique, based at second- or third-hand on Seneca's versions of the Greek, exhibited increasing flexibility in the hands of JOHN LYL, Kyd, and MARLOWE (1563-93), and came to a brilliant climax in SHAKESPEARE (1564-1616). A minor cycle led from Davenant, the Restoration dramatists, and Addison to the better plays of OLIVER GOLDSMITH and RICHARD SHERIDAN. A final cycle began with T. W. Robertson, was carried on after a lapse of decades by H. A. Jones and A. W. Pinero, was further developed by OSCAR WILDE (1856-1900), and ended abruptly when it collided with the revolutionary dramaturgy of HENRIK IBSEN (1828-1906), imitated by G. B. Shaw and John Galsworthy.

In France the "well-made play" of EUGENE SCRIBE and Sardou (1831-1908), important in the history of playwriting because of its unwarranted influence and ignominious eclipse, ruled supreme until the advent of Henri Becque (1837-99), François de Curel, and H.-R. Lenormand. In the United States a long succession of unimportant dramatists, fettered by the outworn traditions of classic technique, rose through DION BOUCICAULT, Bronson Howard, J. A. Herne, and Clyde Fitch, to EUGENE O'NEILL and Elmer Rice, writers owing much directly or indirectly to AUGUST STRINDBERG (1849-1912) and his "Dream Play" and to the Russian, CHÉKOV (1860-1904).

General Principles. The drama differs from other literary forms in that it is an art of story-telling by impersonation. The dramatized lyric of the ancients evolved quickly into a lyricized drama as the participants abandoned third-person narration to identify themselves with characters and, in gradually increasing degree, to disclose their histories by action in preference to unsupported speech. The actor who appears before an audience is, for the time being, the character he represents, and is accepted as such whether his prototype died a thousand years ago or will not live for a thousand years to come.

The immediacy of impersonation before an audience is both advantageous and disadvantageous. Action, visibly portrayed, possesses vividness obtainable in no other manner. Action, consummated in the presence of a large assemblage of spectators, acquires a degree of emotional effectiveness that is unique. "Mob psychology" will lead a body of some hundreds of persons to laugh immoderately, to weep openly, to cheer, to react in fashions that would be unthinkable to any one

solitary auditor. The contagion of emotion sways the crowd as it cannot sway an isolated member of it, an episode which may arouse no particular attention in print often evokes a most emphatic response when portrayed on the stage. What is described comes at second-hand; what is enacted has the direct persuasiveness of reality.

The presence of an audience brings with it limitations. Tempos, both of speech and of action, must be so near those of life that they may be accepted as such. Spoken discourse must be comprehensible at a natural rate of utterance. Failure in the field of poetic drama may frequently be traced to disregard of this requirement. Sequential action, subjected to compression, must nevertheless be convincing both in its substance and in its dealing with the time element.

The audience must understand the play as rapidly as it discloses itself, hence a high degree of clarity is necessary. The printed book permits pauses for reflection. The play, except for the intermissions between the acts, does not. The book permits an author to expound motives, actions and reactions by interpolating psychological dissections. The play cannot pause for such footnotes, invaluable though they might be, for pauses interfere with interest, and interest must steadily rise. The book describes characters, events and places at whatever length it pleases, and has unlimited freedom in its choice of subjects. The play avoids description and particularly avoids narration because they are lifeless substitutes for action; is circumscribed, so far as concerns length, by the period of two or three hours during which a gathering of human beings finds it possible to be steadfastly attentive; and must forever consider beyond its scope personages, actions and scenes which the stage can neither simulate nor suggest.

Dramatic technique may be defined as the art by which the playwright adapts his play to the conditions of his times. A work meant for the modern stage will differ greatly from one intended for the Elizabethan playhouse, and still more from one dedicated to the open amphitheater.

In any play it is necessary for the audience to learn the facts on which the action is based. The ancients lightened the burden by choosing well-known characters and situations, and made free use of the autobiographical monologue. The Middle Ages introduced Biblical and religious personages in the MYSTERY PLAYS, and employed stereotyped figures, Harlequin, Columbine, etc., in less serious works. The sound craftsmanship of Shakespeare, who in the later tragedies was far in advance of his era, did not prevent his successors from following poorer French models, and entrusting exposition to minor characters, servants, visitors and the like, brought on for that sole reason. Modern writing pictures life more faithfully, uses well-known characters and situations only in historical plays, and prefers to accomplish exposition by exhibiting characters in significant action.

Following the creation of a dramatic situation, which may be defined as any state of affairs that

arouses concern for the happiness of the persons involved in it, a play rises in interest to a crisis, a climax and a resolution. This is brought about by a series of growing situations and by profounder character development. "Preparation" is used to focus interest; suspense heightens it; the conflict implied in the beginning, and developed by a scene sequence, comes to a head, is dealt with and leads to a final situation from which elements of doubt have been removed.

The modern audience accepts the convention that it is gazing through a fourth wall, and that the actors are unaware of its presence. Since rant, bluster, theatricalism and even formal rhetoric conflict with that convention, they tend to disappear. The SOLILOQUY and the aside are in a like position. The perfectly good and the entirely bad individual—and the exaggerated situations that may arise from their conflicts—have ceased to be acceptable. The portrayal of authentic men and women, struggling eternally against the forces that surround them, is more interesting and illuminating to an audience.

The "laws" of playwrighting survive only as curiosities: a reasoned psychology has superseded them. Of the so-called Greek unities of time, place and action, only the third retains any validity. (See also DRAMATIC UNITIES.) A newer unity of atmosphere and mood is dominant: the soundly constructed play develops in harmony with a tonality which its earlier scenes have established. The incredible becomes credible if the key is correctly chosen; the credible becomes incredible if it is not.

American Developments. Endogenous growth in America may be identified with Howard, the later plays of Fitch, and those of Augustus Thomas. A freer technique was introduced by Edward Sheldon (1886-), whose use of the "flash-back" (*Romance*, 1913), an improvement on Gerhart Hauptmann's similar device in *Elga*, 1896, and *Hannele's Himmelfahrt*, 1893, was immediately vulgarized in plays of less stature. American has been the development of the technically competent melodrama, preposterous in characterization, but sacrificing everything for a thrill, in the hands of Bayard Veiller (*Within the Law*, 1913, *The Trial of Mary Dugan*, 1928), J. E. Goodman (*The Man Who Came Back*, 1916), and Channing Pollock (*The Sign on the Door*, 1919). American, too, has been the perfection of "hokum," the science of tricking an audience into an unwarranted response.

The business play, always popular, has been reduced to a formula by Roi Cooper Megrue (1883-1927) and George M. Cohan (1878-). Avery Hopwood (1884-1928) perfected the low comedy, hinting at more wickedness than it ventured upon. A taste for the saccharine has been gratified by Pollyanna, *Come Out of the Kitchen*, and *Turn to the Right*, and has been profitable to a few producers of "clean and funny" but spineless plays. Owen Davis (1874-), one of the ablest of modern theater craftsmen, has applied his skill indifferently to the composition of serious works (*The Detour*, 1922, *Icebound*, 1923), farces (*The Nervous Wreck*, 1923), and innumerable melodramas.

The influence of Strindberg on the finer types of American drama has developed the psychographic method, lending itself better to a series of brief scenes, as in the Shakespearean plays, than to orthodox act division. It is exemplified in O'Neill's *Emperor Jones*, 1921, and *The Hairy Ape*, 1922, and with the notable addition of an altogether appropriate expressionism, in Rice's *The Adding Machine*, 1923, and Sophie Treadwell's *Machinal*, 1928. A similar influence is discernible in Marc Connelly and Roark Bradford's work, *The Green Pastures*, 1931. The polished high comedies of PHILIP BARRY (1896-) as yet follow older patterns.

The influence of Chékov is recognizable in Rice's *Street Scene*, 1929, and *The Left Bank*, 1931. Greek tragedy speaks with New England accents in O'Neill's *Mourning Becomes Electra*, 1931.

The universities have stimulated local self-expression, resulting in a group of plays making up to some extent in sincerity and in observation of local material for what they lack in finish, sufficiently typified by the writings of Paul Green and Lynn Riggs. See also EDUCATIONAL DRAMATICS; THEATER SCHOOLS; DRAMATIC THEORY.

P. W.

BIBLIOGRAPHY.—Horace, *Ars Poetica*, Sir Philip Sidney, *An Apologie for Poetry*, 1595; Lope de Vega, *Arte nuevo de hacer comedias en este tiempo*, 1609, Ferdinand Brunetière, *La Loi du théâtre*, 1894, William Archer, *Playmaking*, 1912; G. P. Baker, *Dramatic Technique*, 1919; P. Wilde, *Craftsmanship of the One Act Play*, 1923.

PLEADINGS, in law, formal written statements of what one side affirms and the other denies. The court and jury trying the case are thus apprized of the matter to be decided. It was a common law practice, but has been modified by statutes, so that local requirements vary. The pleadings must be clear, all necessary facts alleged, and all immaterial statements left out. In courts of equity, the pleadings are less formal than in common law, but in all branches of the court the construction of pleadings is more rigid against the pleader.

PLEASANTVILLE, a city of Atlantic Co., N.J., located on an inlet of the Atlantic Ocean, 50 mi. southeast of Philadelphia and 5 mi. northwest of Atlantic City. Its transportation facilities include the Pennsylvania and the Reading railroads and motor bus lines. It is a trading center and has several local industries including stone-cutting and the dyeing and finishing of silks and hosiery. The retail business in 1929 amounted to \$4,560,464. Pop. 1920, 5,887; 1930, 11,580.

PLEBISCITE, a name given to the vote by the electors in a country or specified section of territory on some specific question. The plebiscite should not be confused with the REFERENDUM as it is not a normal and constitutional method of voting on questions, but is a special election called to determine the wishes of the people on some specific question, as, whether or not they approve of some governmental change.

PLEBS. The origin of the plebs is lost in legend, but they seem to have existed from the first at Rome, as the non-patrician (see PATRICIAN) free element of

society, with rights of property, but without vote, or share in the army. They gradually gained the right to all offices, with certain special ones for themselves, of which the greatest was the **TRIBUNE**.

PLECOPTERA, the scientific name for an order of soft-bodied insects, known popularly as stone-flies. They have two pairs of wings, long feelers and usually two tail-processes. The eggs are deposited in the water, where they hatch into nymphs similar to the adult insects, except that they lack wings. These nymphs are common among the stones of mountain streams and clear lakes. When ready for the final molt they crawl out of the water and cling to stones or logs. The perfect insect then emerges from the nymphal skin.

PLEDGE or **PAWN**, a depositing of property with another, as security for a loan or obligation. At common law, pawn and pledge were synonymous. Delivering of the property is essential. Chattels, money and negotiable paper may be used as security. In certain states of the United States, margin deposited by customer with the broker, for purposes of buying and selling, has been held by the courts to create the relation of pledgor and pledgee. Unless there is a special agreement between the parties, the pledge, generally speaking, cannot be used for any other debt except that for which it was given. At common law, an agent cannot pledge his principal's property. *See also* **PRINCIPAL** and **AGENT**.

PLEHVE, VIATCHESLAV KONSTANTINOVITCH (1846-1904), Russian statesman, was born in 1846. He studied law at Moscow University and in 1881 was given the post of Director of the secret service branch of the State police in recognition of his severity while acting as prosecuting attorney in St. Petersburg. In 1884 he entered the Senate and in 1900 became Secretary of State for Finland. As a fanatic reactionary, he was instrumental in promoting a policy of repression in Finland, was accused of having been responsible for the massacre of the Jews at Kishinev and opposed industrial development as undermining autocracy. He was assassinated by Sasanof, a revolutionist, on July 28, 1904.

PLEIADES, in classical mythology, seven daughters of **ATLAS** and the nymph **Pleione**, whose names were **Alcyone**, **Celaeno**, **Electra**, **Maia**, **Merope**, **Aterope** or **Asterope**, and **Taygeta**. They are said to have died from grief either at the loss of their sisters the **Hyades**, or the sufferings of their father. Another story is that **ZEUS** took them to the sky to escape the pursuit of **ORION**, and there changed them into stars. One, always invisible, is supposed to hide herself in shame because she alone of the sisters married a mortal.

PLEIADES, a cluster of stars in the constellation **TAURUS**. The unaided eye can see from 6 to 10 stars in it, while the photographic plate records some 250, ranging from **Alcyone**, **Eta Tauri**, of the third magnitude, down to stars of the 14th magnitude. The distance is about 450 light years.

PLEISTOCENE EPOCH, the first of the two subdivisions of the Quaternary Period in the **CENOZOIC**

ERA of geological history. It means "Most Recent," referring to the life existent then. This epoch includes the **GLACIAL PERIOD**.

PLEKHANOV, VALENTINOVITCH (1857-1918), exponent of Russian Marxism, was born in the province of Tambov, Nov. 26, 1857. He was a leader of the revolutionary organization "Land and Liberty," and in the period 1880-1917 lived as a political exile in Geneva, where he formed the Marxist "Liberation of Labor" group which through his leadership developed into the powerful Social-Democratic party in Russia. In 1914 Plekhanov took the side of the Allies and led the movement for the "revolutionary defense of the country." He founded and edited several socialist journals. After the revolution he returned to Russia, but opposed the Bolsheviks until his death in Finland, May 13, 1918.

PLEOCHROISM, a property of certain translucent and transparent minerals of affecting the color of light according to its direction of transmission through them. Viewed in one direction, the mineral will appear of one color; turned so that light comes through in another direction, its color changes. Some substances show three colors, but dichroism, or two color change, as in **ALEXANDRITE**, is more common. *See also* **MINERALOGY**; **IOLITE**; **CRYSTALLOGRAPHY**.

PLESIOSAUR, any extinct sea-reptile of the order *Plesiosauridae*, numerous represented in shallow Mesozoic seas. Plesiosaurs were commonly characterized by thick, short bodies, smooth skins, short tails, turtle-like flippers, and small snakelike heads raised on inordinately long necks. They varied greatly in size, some species ranging from 30 to 40 ft. in length, though the majority were much smaller. Earlier forms were semi-amphibious, but the culminating species of late Jurassic and Cretaceous time were completely adapted to marine life. The exceedingly sharp teeth suggest that they tore their food as a crocodile does, and the presence of gizzard-stones, in some cases attached to the ribs, makes it probable that they swallowed pebbles to help in grinding their fish food.

Perfect examples of the typical species (*Plesiosaurus dolichodeirus*) from Lias deposits of England and Germany, are exhibited in the British and Berlin museums. In North America the order is represented by the largest of all plesiosaurs, *Megalosauria*, by the short-necked *Dolichorhynchus*, and the great *Elasmosaurus* from Fort Wallace, Kan., of whose total length of more than 40 ft., 22 ft. is neck.

PLETHO, GEORGIUS GEMISTUS (c. 1355-c. 1450), a Byzantine scholar who interpreted **PLATO** to the Western World. In 1439 he was sent as a delegate to the conference at Florence in the interests of promoting unity between the Greek and Roman churches. Here Cosmo de Medici was attracted to him and invited him to remain in Florence. This he did, and in 1440 founded a Platonic Academy there. He was an authority on conditions in the Peloponnesus and defended **PLATO** against **ARISTOTLE** in his time. He also promoted a Neo-Platonic sect. His *Distinctions between Plato and Aristotle* was pub-

lished in Venice in 1540 and a work on *The Religion of Zoroaster* in Paris in 1538.

PLEURISY, inflammation of the pleura, the lining membrane of the chest cavity. It may be "dry" or there may be a collection of fluid. The dry type follows such diseases as pneumonia, tuberculosis or tumors or abscesses of the pleura. The symptoms consist of pain in the side, cough and fever. (See also INFLUENZA)

The causes of the second type, known as pleurisy with effusion, are tuberculosis, acute rheumatism, tumors of the lung, chronic kidney disease, and infections of the pericardium. It occurs generally between the ages of 20 and 40 years. The condition may start suddenly or gradually. There is pain in the side, together with cough, shortness of breath and fever. The fluid can be detected upon examination. An X-ray aids in making a diagnosis.

The tendency is for the fluid to be absorbed. Sometimes it is withdrawn by the use of an aspirating needle and syringe. Pain may be relieved by hot or cold applications, by strapping the chest or giving narcotics. The patient should be put to bed, and a laxative given if necessary. Further treatment depends upon the cause.

The prognosis is fair with proper treatment. Examination of the fluid is valuable in determining the cause for the condition.

PLEURISY ROOT, a name given to the BUTTERFLY WEED, a species of milkweed with orange-red flowers, used as an ornamental plant and also in medicine.

PLEURO-PNEUMONIA, in cattle, a contagious disease affecting the lungs and pleura and producing a special form of lobar-pneumonia. The exact causative organism is unknown, and the disease may last from three weeks to three months. The chief symptoms are fever and general indications of a lung and chest disease, including coughing and rapid breathing. There is progressively great debility and emaciation and recovery is rare.

Protection by inoculation is extensively practised, lymph from a diseased lung being injected in the extremity of the tail. However, immunity appears to be only temporary.

PLEVNA (Bulgarian *Pleven*), a city in northern Bulgaria, 25 mi. from Nikopoli on the Danube River, and lying on the railway connecting Varna, the chief Bulgarian port on the Black Sea, with Sofia, the capital. The city has a large trade in cattle and is the center of the wine industry of northern Bulgaria, the government center for the region being located at Plevna. The house in which the Russian emperor received Osman Pasha at the close of the BATTLES OF PLEVNA in 1877 is now a museum, housing documents and relics of the war. A mausoleum contains, in addition to the flags, armor and other mementoes of the battles, heaps of skulls of the dead. Pop. 1931, 28,658.

PLEVNA, BATTLES OF, a series of battles fought between the Turkish army under Osman

Pasha against the Russians under Gen. Schildner-Schuldner, later assisted by Rumanian troops, during the RUSSO-TURKISH WAR in 1877, in the course of the siege of Plevna, a small Bulgarian city. The Turks occupied the unfortified city on July 19 and the following day the Russians attacked and were driven back. Osman now hurriedly built fortifications and redoubts. On July 30, a second Russian attack was repulsed with serious losses to the Russians. The third battle occurred on Sept. 7 and continued four days. With about 85,000 troops, the Russians planned to attack from three sides. Again the Turks withstood the bombardment. The siege continued until Dec. 10, when supplies gave out, and Osman attempted to escape during the night, but was prevented and forced to surrender with his entire army.

PLINY THE ELDER (GAIUS PLINIUS SECONDUS) (c. 23-79 A.D.), Roman polyhistorian, was born probably at Novum Comum, northern Italy, about 23 A.D. Most of his life was spent in the service of the State, in which he occupied various military and civil posts. At the time of his death he was in command of the fleet stationed at Misenum. In spite of his official duties, however, he managed, by rigid economy of time, to do an enormous amount of reading and acquired a book knowledge encyclopedic in breadth. This wide learning was reflected in the extensive and varied nature of Pliny's writings, which included works on history, military tactics, grammar, rhetoric, biography and natural science. Of these, the only work that survives is his celebrated *Historia Naturalis* or *Natural History*, in 37 books. This ancient encyclopedia of natural science, completed in 77 A.D., consists chiefly of a vast compilation of matter culled from some 2,000 different writings representing 146 Roman and 327 foreign authors. It is not surprising that such a stupendous work, written hastily in an uneven style by a man whose learning was much more comprehensive than it was deep, should contain a large number of errors. Nevertheless the *Natural History* has been of inestimable value as an index to the arts and sciences of Pliny's time. His zeal for investigation led Pliny to his death in 79 A.D. at the eruption of Vesuvius, so vividly described by his nephew, PLINY THE YOUNGER.

BIBLIOGRAPHY.—English translations by P. Holland, 1601, Bostock and Riley in Bohn's Library, 1855-57, and others.

PLINY THE YOUNGER (Gaius Plinius Caecilius Secundus) (c. 62-c. 113 A.D.), Roman author and nephew of PLINY THE ELDER, was born at Novum Comum, northern Italy, about 62 A.D. After his father's early death, he was adopted by his famous uncle, to whom he was greatly indebted for his remarkable education. He began his public career at 19 as an advocate, and later held numerous official posts under Domitian and Trajan, receiving many favors from the latter. In his circle of friends were the most celebrated men of his time, including Tacitus, Quintilian, Martial and Suetonius.

Pliny was an able orator, but his fame rests chiefly on his literary work. His writings included a number

of published speeches, some poems and several books of letters, but there remain of these only one speech, the *Panegyric on Trajan*, and 10 books of *Letters*. The first nine books of the latter contain epistles to various friends on a great variety of subjects; the tenth comprises Pliny's correspondence with the Emperor Trajan. Besides their literary merit, the *Letters* are valuable for the descriptions they give of Pliny himself, his friends and of Roman life in general. Pliny died about 113.

BIBLIOGRAPHY.—English translations of Pliny's *Letters* by J. D. Lewis, 1879, E. T. Merrill, 1903, and others; E. S. Hardy, *Correspondence with Trajan*, 1889.

PLIOCENE EPOCH, the fourth and last subdivision of the Tertiary Period in the CENOZOIC ERA of geological history. It means "More of the Recent," referring to the life then existent.

PLOESTI, capital of the Rumanian district of Prahova. It is the center of the wool trade and petroleum industry of the Prahova Valley, has advanced vocational, trade and other schools. Its exports are textile and agricultural products. Pop. 1930, 77,325.

PLOTINUS (c. 205-c. 270), a leading philosopher of the Neo-Platonic school, was born at Lycopolis, Egypt, about 205. He attended the lectures of the most celebrated men at Alexandria where he became the disciple of Ammonius Saccus, founder of Neoplatonism. In 242 he set out with the Emperor Gordian for Persia, hoping to study Persian and Indian philosophy at first hand. When the campaign failed Plotinus was forced to flee to Antioch whence, in 244, he went to Rome. There he taught philosophy with marked success. His sincerity and loftiness of spirit made him widely popular; the emperor Gallienus was an enthusiastic follower.

The philosophy of Plato is the foundation of the system of Plotinus, who is regarded by many as the greatest philosopher of eclectic mysticism. Plotinus died in Campania about 270.

PLOVDIV. See PHILIPPOLIS.

POLOVER, a group (*Charadriinae*) of shore birds allied to the snipes and sandpipers, but differing from them chiefly in their rather short, somewhat pigeon-

tide flats, and also sandy plains and grassy uplands, where they feed largely on worms and insects. They lay 3 or 4 spotted buffy eggs in slight depressions, usually with little or no nesting material. Numerous species are widely distributed throughout the world; many are highly migratory and of exceedingly wide range. Several are prized as game birds.

Of 8 species found in the United States, the best known is the KILLDEER. The golden plover (*Charadrius dominicus*), about the size of a robin, with black upper parts marked with golden yellow and black underparts during the breeding season, breeds from the shores of the Arctic Ocean southward to Hudson Bay, migrating with the approach of winter to Brazil and Argentina.

PLOWS, the principal implements for preparing fields before planting crops. There are two types, moldboard and disk. The moldboard plow bottom is a hollow, three-sided wedge of polished steel or cast-iron designed to operate beneath the surface. Its cutting edge, or share, loosens a slice of soil, called a furrow slice, 6 to 24 in. wide, which the curved upper part or moldboard, lifts and deposits in the adjoining open furrow in an inverted position, thereby covering plant growth. The colter, a stationary or rolling knife mounted above the point of the share, aids by cutting roots and trash. The jointer, a miniature plow beside the colter, turns trash toward the furrow opening. Pull is transmitted to the plow bottom through a hook-shaped beam and adjustable hitch. In most soils two horses can draw a bottom cutting a furrow slice about 14 in. wide and 6 in. deep.

Disk plows have one or more saucer-shaped steel blades, 20 to 28 in. in diameter, set at an angle to the furrow and free to revolve. They are used in sticky or very hard soils, and in semi-arid regions where it is desirable to stir the soil without turning it entirely over. See also LISTER; RIDGER; SUBSOILER; STEAM PLOWS; CULTIVATORS.

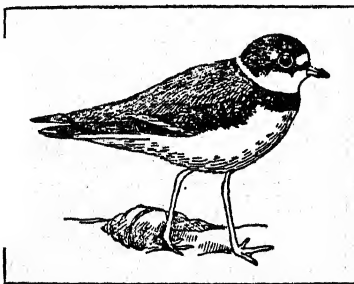
W. A.

BIBLIOGRAPHY.—J. B. Davidson, *Agricultural Machinery*.

PLUCKING BOARD. See SELECTION BOARD, NAVY.

PLUM, the name for a group of small trees or shrubs of the rose family widely grown in temperate climates for their smooth skinned fruit and for their flowers or ornamental foliage. With the exception of the grape, no fruit grown in America presents such a wealth of species, two from Europe and western Asia; two from China, one of them by way of Japan, hence called Japanese varieties, and eight native American.

Of these, varieties developed from the European plum (*Prunus domestica*) are most important. They are the plums of European and colonial history. Their range of successful commercial cultivation is comprised in two chief areas. One extends from Massachusetts to Michigan and southward to Pennsylvania and Ohio; the other is on the Pacific coast. They have been classified in four groups: Prunes, firm-fleshed sweet fruits that dry well; Damsons, very small, firm-fleshed, mostly tart varieties suited to culinary purposes; Gages, mostly green or yellow,



G. M. SUTTON, "BIRDS OF PENNSYLVANIA"
J. HORACE MCFARLAND CO. COPYRIGHT

SEMI-PALMATED PLOVER
Charadrius semipalmatus

like bill. They are small or medium-sized birds of stout, compact build. More or less gregarious, except during the nesting season, they move often in small flocks, frequenting low moist grounds, as beeches and

juicy, high quality dessert kinds; and Large, mostly juicy kinds not well adapted to prune making. Another European and west Asian species (*P. cerasifera*) has produced several varieties but is most used as a budding stock for other plums.

Though Japanese plums (*P. salicina*) were not grown in America until about 1870 they now rank second in importance. Their earliest varieties ripen a month or more before the European ones and, in both areas, especially on the Pacific coast, they are grown commercially for eastern markets. They succeed also in the South and parts of the Middle West. Another Chinese species, the apricot plum (*P. Simonii*), is grown commercially in California and to a lesser extent in home gardens elsewhere.

Varieties of the native species (*P. nigra* and *P. americana*) are so hardy they may be grown in sections of northern United States and adjacent Canada where the European and Japanese kinds are killed by cold. Those derived from *P. hortulana* and *P. angustifolia*, which grow wild from Michigan to Texas, are adapted to the South where, because of the heat and fruit-rot, other plums fail. The beach plum (*P. maritima*), which grows on the coast from New Brunswick to Virginia, is planted mostly for ornament though it has developed a few varieties. The same may be said of the Pacific coast plum (*P. subcordata*).

European plums thrive best on clay loam soils, the other kinds on lighter ones. All require well drained land but those of *P. americana* origin attain largest size and best quality on rather moist soil or when mulched during summer. The trees are usually planted about 20 ft. apart when two years old, given clean cultivation and trained for low heads. Black knot is the most destructive of plum diseases. (See FUNGICIDES.) The most destructive insect is the curculio whose larvæ attack and destroy the fruit or make it wormy. See INSECTICIDES. M.G.K.

PLUMBAGO. See GRAPHITE.

PLUMBING, in a building, includes pipes for distributing water, fixtures for using water, and drainage pipes for removing waste water and SEWAGE, together with fittings and appurtenances of various kinds, all within or adjacent to the building. It includes the service pipe which forms the connection between the water main and the building, and the house sewer which conveys waste water and sewage from the building to the SEWER. Connections for rain water are also included, if it is discharged through the house sewer. The arrangement of the plumbing system and the sizes of the pipe used have an important bearing on the consumption of water and the amount of waste. If the water distribution of a building is well proportioned, the use of wafer at one fixture will not prevent water from being drawn from another fixture fed by the same pipe. Similarly, if the waste and soil pipes are of proper size, the danger of clogged drains is minimized.

Water piping may be of lead, copper, brass, iron or steel, plain, galvanized or lined with tin or lead. All these materials vary greatly in their resistance to

corrosion. Lead resists corrosion very well except for water carrying an excess of carbon dioxide. Plain iron and steel pipe rust very quickly, color the water and leave stains on the plumbing fixtures and clothes. Galvanized pipe is deprived of its protective coating at threaded joints and corrodes rapidly. Galvanic currents are often set up in lined pipe, resulting in corrosion. Brass and copper pipe cost more but are highly resistant to corrosion. House sewers are usually cast iron but are sometimes laid with vitrified clay pipe when on solid foundations. Inside the building all drains and vent pipes are of cast iron. E. E. W.

BIBLIOGRAPHY—U.S. Department of Commerce, *Recommended Minimum Requirements for Plumbing*.

PLUMB PLAN, a proposal for the reorganization of the railroads of the United States, submitted to Congress in 1920 by Glenn E. Plumb, counsel for the railway brotherhoods. The Plumb plan contemplated purchase of all railroads by the national government for a price based upon the original cost of the properties. Once bought, the railroads were to be turned over to a National Operating Corporation, which was to run them so as to earn at least the expenses of maintenance and operation, together with interest on government BONDS issued to accomplish the purchase. Any surplus was to be divided equally between the Government and the Corporation; and the Corporation's share was to be distributed as a dividend among its employees. General management was to be in the hands of a board of directors of 15 men, five to be appointed by the President of the United States, five to be elected by the officials and five by the other employees. The employees, therefore, were to exercise control. Salaries, wages, hours and working conditions of employees were to be determined by the board of directors in the first instance, but they were subject to change by a central board of wages and working conditions composed entirely of elected representatives of the employees. Mr. Plumb expected great things from his plan in the way of lower rates and higher wages in the railroad field, but public opinion, on the whole, rejected it as unsound except possibly as a device for raising railroad wages at the expense of the general taxpayer. After the passage of the Transportation Act of 1920 interest in the proposal rapidly disappeared. S.D.

BIBLIOGRAPHY—G. E. Plumb and W. G. Roylance, *Industrial Democracy*.

PLUM CURCULIO, a species of snout beetle (*Conotrachelus nenuphar*) of the order Coleoptera. Next to codling moth larvæ, it is perhaps the most destructive of orchard pests. The adults appear from hibernation in early spring and feed on plum foliage. After the flowers fall they lay eggs in the young plums. The grubs hatch and feed inside the plums, causing them to fall or ripen prematurely. Pupation takes place in the ground. Other fruits attacked include apricot, cherry, nectarine, peach, apple and pear. Spraying foliage with arsenicals at the time adults are feeding is the best means of control.

PLUME GRASS (*Erianthus saccharoides*), a perennial reedlike grass of the southern United States with long flat leaves and large, oblong, densely woolly flowering panicles. It is a robust erect plant, 3 to 10 ft. high, too coarse for grazing and forage purposes but suitable for ornamental planting in sandy soils.

PLUME POPPY (*Macleaya cordata*), a tall perennial herb of the poppy family, called also tree celandine. It is a native of China and Japan widely grown as a border ornamental. The erect stems, 5 to 8 ft. high, bear long-stalked, heart-shaped, often very large leaves and numerous small pinkish or cream-colored flowers produced high above the foliage in feathery, terminal clusters sometimes a foot in length.

PLURALITY, a term used in politics to designate the number of votes (*see also* VOTING) by which the candidate receiving the largest number of votes for a particular office exceeded the total of his closest rival. Thus if A received 50,000 votes for the office of mayor, B 40,000 and C 10,000, A may be said to have won by a plurality of 10,000.

PLUTARCH (c. 50-120 A.D.), Greek writer, was born at Chaeronea in Boetia, about 50 A.D., of a wealthy family. His life was scholarly and peaceful, and few of its external incidents were conspicuous enough to be recorded or remembered. He lectured on philosophy in Greece and in Italy. He returned from Rome to his own country in his latter years, and died at Chaeronea, about 120. His sympathies are always manifestly with Greece, the conquered nation. He uses many quotations from the Greek, but he neither mentions nor quotes from his Roman contemporaries, the Plinys and Tacitus. Plutarch's writings make up two principal works, the *Moralia* or *Moral Essays*, and the *Parallel Lives*. The *Moralia* is a collection of 60 treatises covering a wide range of subjects, including morality, religion, physics, metaphysics and archaeology. Several are in dialogue form and are highly entertaining, as for example the *Gryllus*, a brilliant conversation between Odysseus, Circe and a pig. The author of the *Moralia* has been compared for his learning, wit and broad human sympathies with the eminent 16th century French essayist, MICHEL DE MONTAIGNE. Far better known than the *Moralia* is the *Parallel Lives*. This work consists of 46 biographies of great Greeks and Romans, so arranged in pairs that the life of a notable Greek is followed by the life of a Roman who is distinguished in the same field; in some instances the comparisons are ill-drawn. Plutarch was a biographer, not a critical historian. His chief interest was the personality of the soldier, statesman or law-maker he was writing about, and his personal anecdotes often decipher character better than could pages of ordinary biographical writing. In historical matters he was frequently mistaken, but on the other hand his political backgrounds are generally excellent. In describing a great man he disdained to use pathos or dramatic devices, achieving his effects simply by his own earnestness. The *Parallel Lives* is one of the most enjoyable and best loved books of an-

tiquity. It was first translated into English by Sir Thomas North, from the French version of Amyot, and published in 1579. Upon North's translation SHAKESPEARE based his historical dramas, *Coriolanus*, *Julius Caesar* and *ANTONY AND CLEOPATRA*. *See also* GREEK LITERATURE.

BIBLIOGRAPHY—*Plutarch's Lives*, corrected from the Greek and revised by A. H. Clough, 1885, *The Roman Questions*, trans. by H. J. Rose, 1924, *Moralia*, ed. by D. Wyttenebach and G. N. Bernardakes, with English trans. by F. C. Babbitt, 1927.

PLUTO or **HADES**, in Greek mythology, the god of the infernal regions. *See* HADES.

PLUTO, the ninth planet in order of distance from the sun, discovered in 1930, after years of searching. The planet's existence had been surmised from minute irregularities in the motion of Uranus, and many predictions of its position had been made. The new planet appears as a star of the fourteenth magnitude. It is probably smaller in size than the earth and less massive.

It may take many years before the elements of its orbit can be accurately determined. It appears, however, that Pluto revolves about the sun in 252 years at an average distance of 3,700 million miles. The planet's orbit makes the large angle of 17 degrees with the plane of the ecliptic, more than twice as large as that of any other planetary orbit. The orbit is so elongated that at times the planet may approach to within less than 2,800 million miles of the sun, and thus come inside the orbit of Neptune. At other times it may recede to 4,700 million miles.

PLUTONIC ROCKS. *See* ABYSSAL ROCKS.

PLUTUS, in Greek mythology, the giver of riches, son of DEMETER and Iasion, was blinded by ZEUS in order that he might dispense wealth indiscriminately. He was usually represented as a child in the arms of a goddess.

PLYMOUTH, a seaport of Devonshire, England, situated on the east side of a peninsula between the rivers Plym and Tamar, at the head of Plymouth Sound, 231 mi. southwest of London.

The original Plymouth was a little settlement at Sutton Pool, near the famous promontory called the Hoe. It was from the old quay in Sutton Pool that the Pilgrim Fathers sailed to America on the *Mayflower*, 1620. It became an important naval station from the fourteenth century, when it was first fortified, and now, with Devonport and Stonehouse, forms one large populated area called the Three Towns. To secure good anchorage in the Sound a large breakwater was recently constructed at a cost of \$10,000,000. The western harbor at the mouth of the Tamar is devoted specially to the navy, and here is the dockyard. The mercantile marine is accommodated in the eastern harbor on the estuary of the Plym, in Sutton Pool and the Great Western Railway docks in Mill Bay. The Hoe has been laid out as a promenade and recreation park. It contains Eddystone Lighthouse and a handsome statue of Sir Francis Drake by Boehm. In the newer parts of the town are many handsome buildings. The guildhall is a fine Gothic

structure built in 1870-74 with a tower 200 ft. high. The citadel, an obsolete fortification built by Charles II, is an object of interest. The manufactures are not extensive and are chiefly connected with ship's stores; but the fisheries are important. Pop. 1921, 210,036; 1931, 208,166.

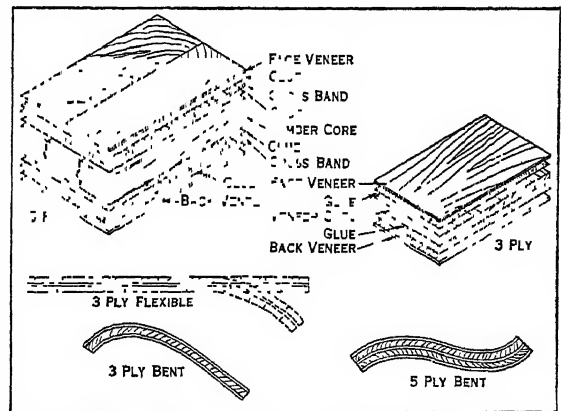
PLYMOUTH, a city in northern Indiana, the county seat of Marshall Co., situated on the Yellow River, 120 mi. north of Indianapolis. Bus lines and three railroads afford transportation. Plymouth is a shipping market for the crops of the vicinity, alfalfa, corn, wheat and dairy products. The chief local manufactures are baskets and automobile accessories. There are undeveloped mineral springs in this region. Five mi. south of the city is a monument to Menominee, the chief of the Potawatomi Indian tribe, who once owned Marshall Co. Plymouth was founded in 1836 and incorporated in 1851. Pop. 1920, 4,338; 1930, 5,290.

PLYMOUTH, a town including the historic village of Plymouth and several smaller villages in southeastern Massachusetts. Plymouth town, the county seat of Plymouth Co., is situated on Plymouth Bay, an inlet of Cape Cod Bay, 37 mi. southeast of Boston. It is served by the New Haven Railroad, motor buses and steamships. The traffic of Plymouth harbor in 1929 amounted to 38,394 tons, worth \$2,120,276. The newer section of Plymouth town has numerous factories and one of the largest rope-making plants in the world. The manufactured output of the entire town was worth about \$25,000,000 in 1929. It was here that the pilgrims from Plymouth, England, who set out on the *Mayflower*, landed Dec. 21, 1620. The Rock, on which, according to tradition, they first set foot is visited every year by thousands of tourists. Plymouth is an attractive summer resort. The prominent landmarks include Burial Hill where Gov. William Bradford is buried, the registry building with the original records of the colony, and the Crowe house, built in 1664. The town was never incorporated but was recognized as the seat of government of the colony in 1633. Pop. 1920, 13,045; 1930, 13,042.

PLYMOUTH, a borough in Luzerne Co., northeastern Pennsylvania, situated on the Susquehanna River, opposite Wilkes-Barre. It is served by the Delaware and Hudson and the Lackawanna railroads. The borough lies in the beautiful and historic Wyoming Valley, in a highly productive anthracite coal region. Mining is the leading industrial interest. There are also several local manufactures, principally silk. The factory output, 1929, was worth \$1,148,352. In 1929 the retail business amounted to \$5,386,207. The borough has been a coal-shipping point since 1808. The Susquehanna Company of Connecticut was instrumental in sending settlers here in 1769. Plymouth was the center of the Pennamite-Yankee Wars, which broke out in 1784, caused by a dispute between the settlers and the State concerning land titles. The borough was incorporated in 1866. Pop. 1920, 16,500; 1930, 16,543.

PLYMOUTH BRETHREN, the popular designation of independent groups of Christians sometimes called "Darbyites," after their founder, John Nelson Darby (1800-82), who refer to themselves simply as "Brethren," "Christians," "Believers," and the like. Their first permanent meetings took place in 1829, Plymouth and Bristol in England being the chief centers of the movement. They unite principally for "the breaking of bread" and for prayer, emphasize the verbal inspiration of the Bible and the second coming of Christ, and protest against sectarianism and church organization. In the United States they appeared in 1885, and are divided into "Open" and "Exclusive" Brethren. A third and fourth division 5 years later and the fifth and sixth groups, so-called, were organized in the first decade of the present century. The total membership of all groups is about 20,000, representing approximately 500 local organizations. They have no clergy but do extensive missionary work.

PLYWOOD, a type of laminated wood designed to utilize lumber more economically, since the cutting of VENEER eliminates the wasteful saw kerf. The dominant strength of wood is lengthwise, with the grain. Its principal weakness is crosswise, in which direction it has serious shrinking and swelling qualities and minimum tensile strength. Standard plywood is made by alternate cross laminations of thin sheets of veneer together with heavier centers of thick



STRUCTURAL FEATURES OF STANDARD, FLEXIBLE AND BENT TYPES OF PLYWOOD

veneer or lumber, usually in five-ply or three-ply, as illustrated.

Plywood also serves as a substantial foundation for the laying of beautifully figured and expensive veneers, which in solid wood would distort and crack and would be prohibitive from a cost standpoint. The popular impression that the surface veneer is intended to conceal a cheaper wood is erroneous. The fact is that a sturdy wood base gives strength and permanence to the fragile face veneer, and utilizes economically and efficiently both woods of strength and woods of beauty. Plywood processing requires accurately cut sheets of veneer, both in horizontal and vertical di-

mensions, together with a glue that is stronger than the wood itself.

Plywood is used extensively in the manufacture of FURNITURE; practically all flat surfaces are better made of plywood than solid wood because of the balancing of internal stress and strain. Tests have proved that properly designed plywood, pound for pound, is stronger than steel. Other uses of plywood are interior paneling, wainscoting, wall board, sub-floors, top floors, weather boarding, flush and panel doors. In addition, plywood is extensively used in industry for electrical and radio art due to its high insulation value. It can be made flat or bent to a variety of rigid curved forms, as well as in flexible and semi-flexible types.

T. D. P.

PLZEŇ (German *Pilsen*), a city in Czechoslovakia, situated between the Mze and Radbusa rivers, famous for its industry and beer. Plzeň consists of the city proper, regularly laid out, and the suburbs separated from it by parks. It has an early-Gothic church dating from 1292, a Franciscan abbey with a Gothic chapel, a city hall with the banquet hall in which Wallenstein's generals took the oath of fidelity, and the West Bohemian Handicraft Museum. Besides having three great breweries, Plzeň is the seat of the largest engineering works and steel mills in central Europe, the famous Skoda works, which in their full capacity employ up to 45,000 workmen and employees. The city is also an important trade center, particularly for horses and cattle, wool, feathers, leather and textiles. In 1921 there were 88,416 inhabitants. Since then, the suburbs have been united to the city proper. Pop. 1930, 114,150.

PNEUMATIC CONVEYING. Compressed air or vacuum, or both in combination, may be used in conveying certain materials such as sawdust, and dust from grinding and other operations. Vacuum cleaning is also used in conveying dirt from floors and from otherwise inaccessible places. Loosened core sand in hollow castings is so removed. Air compressed behind carriers in tubes forces them through pipes and frequently for long distances. See PNEUMATIC DISPATCH.

PNEUMATIC DISPATCH, a method for transporting comparatively small packages or loose material by the use of compressed air. The material is put into a "carrier," or light, hollow shell with a suitable cover and with a packing on each end to prevent the escape of air. Compressed air admitted behind the carrier forces it through the tube. One of the first important uses for this method was to send mail from the main postoffice to substations in some of the large cities. The system is still extensively used for this purpose. Smaller tubes are employed in large department stores for sending money to the cashier's desk in making change for customers. Miles of pipes are used in this way. Similar systems are employed in factories to send orders and messages from one department to another. F. H. C.

PNEUMATIC POWER TRANSMISSION. See POWER TRANSMISSION, PNEUMATIC.

PNEUMATICS, in the broadest sense, includes the whole of that part of physical science which has to do with the mechanical properties of gaseous materials. In a more restricted and usual sense, it is the mechanics of compressed air and of compressed air machinery, since it is in this field that the most important modern applications are found. In this latter sense it is an important and highly specialized branch of engineering dealing with the AIR COMPRESSOR, with problems concerning the transmission of power by compressed air, and with the numerous devices, such as pneumatic drills and riveters, which utilize power transmitted from a compressor. See also PNEUMATIC TOOLS.

PNEUMATIC SUCTION CLEANING. See VACUUM CLEANING.

PNEUMATIC TOOLS, mechanical devices, such as rivet hammers and drills, driven by compressed air. Pneumatic tools are divided into two general classes, percussion and rotary or reciprocating-motor driven. Both types have a wide variety of applications, being used in all kinds of construction and demolition work.

Percussion pneumatic tools include such tools as hammers, riveters, rock drills, sand rammers, chippers, tampers and pavement breakers. The power element comprises, essentially, a piston, a cylinder, an operating valve and a throttle valve. Compressed air is admitted through the throttle valve, controlled from the handle of the tool. It then passes into a valve chamber containing the operating valve, which is moved back and forth in a valve box by air pressure. As it moves toward the cylinder, air is admitted back of the piston throwing it forward so that it strikes the head of the tool. After delivering the blow, the piston is driven back to its former position by air automatically admitted to the front of the cylinder. Sometimes a separate operating valve is omitted, the piston being shaped so that it functions both as a valve and piston.

Rotary pneumatic tools include such tools as drills, grinders, wrenches and air hoists. The powered element consists, essentially, of a series of vanes which rotate on a spindle in a casing having a suitable inlet and outlet for the air. Reciprocating-motor rotating tools utilize a V-type air motor with one crank throw provided for each pair of pistons in the same cross plane. The power is transmitted from the crankshaft to the spindle operating the tool by a set of gears. A main valve of the rotary type controls the supply of air to each of the cylinders. A small type of reciprocating-motor tool employs a three-cylinder radial air motor. In this type, the main spindle functions as a valve to control the supply of air to each of the cylinders.

In field work compressed air is supplied to pneumatic tools by portable air compressors driven by INTERNAL COMBUSTION ENGINES and occasionally electric motors.

PNEUMOCONIOSIS, a disease caused by the reaction of the body to the absorption of quantities

of finely divided rock dusts in the lungs. Particulate matter which reaches the air-sacs is picked up by phagocytic cells which lie between the sacs. Large particles are more easily disposed of than very small ones. These latter tend to accumulate within the cells which ingest them. These laden cells conglomerate, and are surrounded by other cells, forming tubercles which later break down. Such lesions form a well-prepared seed bed for tubercle bacilli, which, once gaining entrance, rapidly undermine the health of the patient.

Pneumoconiosis, or dust disease of the lungs, occurs in workmen of many dust-raising occupations, such as coal-mining, (anthracosis or miners' phthisis), quarrying, metal-working, grain-threshing, etc. Organic dust is more dangerous than inorganic dust.

PNEUMONIA. The lungs, in their healthy state, are composed of spongy, porous tissue so constructed that the inspired air comes in close contact with the circulating blood. When the lungs become the site of infection by bacteria, the products of inflammation fill up the air cells, and the lung, instead of presenting the usual spongy appearance, becomes more or less solidified. This condition is spoken of as pneumonia. In general pathologists classify pneumonia into two groups, bronchial pneumonia and lobar pneumonia.

BRONCHIAL PNEUMONIA

Bronchial pneumonia occurs chiefly in infants and old people, though it may develop at any age, particularly after an extended illness or after influenza. Bronchial pneumonia is characterized by patches of consolidation, which can be felt in the lung, and which convey the sensation of small lumps throughout the substance of the organ.

Various bacteria may cause bronchial pneumonia, but the commonest agents are the pneumococcus.

Bronchial pneumonia is a serious infection when it occurs in infants or the aged, but in the average adult it runs a comparatively mild course. The exception to this rule is the so-called influenzal pneumonia, which occurs with great frequency in epidemics of influenza and often has a high mortality rate. (See also CHILDREN, DISEASES OF; INFLUENZA.)

The onset of bronchial pneumonia is usually gradual. The fever, which is of the remittent type, rises to between 101° and 104° F., the respiration and pulse become more rapid, and the constitutional disturbance is more or less pronounced. Cough may be frequent and distressing, and the sputum is usually increased in amount. Cyanosis is a frequent symptom. Convulsions and intestinal symptoms are common in young children.

The treatment of bronchial pneumonia is usually "symptomatic." There is no serum treatment for this form of the disease, so the physician treats the symptoms as they develop.

LOBAR PNEUMONIA

Lobar pneumonia is characterized by massive consolidation of an entire lobe, sometimes even of an

entire lung. The sponge-like consistency of the organ is entirely lost and the solidified lung feels like liver.

Lobar pneumonia is caused almost always by some form of the pneumococcus. Pneumococci are classified into a number of biological groups, but they all produce practically the same picture in the lung and essentially the same clinical picture. The commonest types are Types I, II, and III, which together constitute 70 to 75% of all lobar pneumonias. The remaining types are often grouped together and spoken of as Group IV, but as a matter of fact approximately 25 other types have been isolated and each of these is capable of exciting a genuine lobar pneumonia. Pneumococcus Type I pneumonia is the commonest of the types (30-35%). This is fortunate, as it is the type most amenable to serum treatment.

Though pneumococci may be present in the circulating blood in pneumonia, efforts to produce the disease experimentally in monkeys by injecting pneumococci into the blood stream have consistently failed. By injecting pneumococci directly into the windpipe, however, experimental pneumonia in monkeys is readily produced, with the pneumococci subsequently invading the blood stream. It is now generally established that the "portal of entry" in pneumonia is through the air passages.

The onset of lobar pneumonia is usually sudden, with a chill and pain in the side. The face becomes flushed, often purplish. The respiration is labored, rapid and shallow. The temperature ranges between 103° and 105° F. Cough is a common symptom and at first is of a dry, hacking character. Later on, sputum makes its appearance, at first pinkish or blood-streaked, then rusty or dark brown. Cyanosis (purplish tinge of lips and skin) is usually present in severe cases. The demonstration of pneumococci in the blood indicates a severe infection. Delirium is present in about 25% of cases. In children, the disease may be initiated by a convulsion and other cerebral symptoms suggestive of meningitis. Abdominal distention is frequent and troublesome. Pneumonia may terminate suddenly by a "crisis" or by gradual resolution. In fatal cases, the immediate cause of death is generally some form of heart failure, or one of the complications of pneumonia. The most important complications are empyema, meningitis, pericarditis and endocarditis.

In a typical case of lobar pneumonia, the diagnosis can usually be made within a few hours after onset, but there are exceptional cases in which any one or several of the characteristic signs may be absent and thus delay the diagnosis for a day or two. As proper and effective treatment depends upon early diagnosis and determination of the type of bacterial infection, prompt recourse should be made to laboratory aids. Identification of the type of pneumococcus can be made by bacteriological examination of the sputum, by a "blood-culture," and sometimes by certain tests on the urine. X-ray examination of the chest may be of great help in early diagnosis.

The treatment of lobar pneumonia must look first

to the relief of distressing symptoms and good nursing. A liquid diet should be maintained. Quiet, sleep and proper ventilation are important. Stimulants should be administered on the first evidence of heart failure. Oxygen treatment is indicated for "blue" patients. The rational application of serum in pneumonia depends upon the early identification of the type of infecting pneumococcus. The most striking effects of serum therapy have been observed in Type I cases. The results are less satisfactory in Type II infections. For Type III and Group IV infections, no effective serum has as yet been developed. Serum cannot be employed for patients who are sensitive to horse-serum.

Lobar pneumonia is an infectious disease, and every precaution should be taken against its transmission to others. The elimination of the common cold would go far toward preventing pneumonia, as most patients give a history of a previous respiratory infection. Immunity conferred by vaccine has so far been restricted to prophylaxis against Types I, II and III, and the protection established by vaccination is of comparatively short duration, probably less than a year. Vaccination against pneumonia is particularly indicated for people who are subject to recurring attacks of the disease.

R. L. CE.

For complications by other diseases, see MENINGITIS; PERICARDITIS. See also TULAREMIA.

PNEUMONIC PLAGUE. See PLAGUE.

PNEUMOTHORAX. The lungs are kept expanded because of a negative pressure which exists within the pleural cavity drawing their elastic tissue to the limit of its confines, the chest wall. The introduction of gas or air into the pleural cavity and the destruction of this normal negative pressure is known as pneumothorax, and usually results in a collapse of the lung. Pneumothorax may occur either accidentally, or may be induced therapeutically in the treatment of disease.

Spontaneous, or accidental pneumothorax, is usually due to the rupture of the lung into the pleural cavity following the breaking of a bleb, or blister, full of air (EMPHYSEMA); the rupture of an abscess, tuberculous or otherwise; or the evacuation of an infection (Empyema) in the pleural cavity through the lung into a bronchial tube. It may also occur following injury to the chest wall, in which a rib may penetrate the pleura, or a foreign body from the outside may entirely penetrate the chest wall. The predominating symptoms are sharp pain in the side, marked shortness of breath, associated with the complete collapse of the lung. In many cases, the irritation to the pleura occurring in spontaneous pneumothorax causes the formation of a fluid which may be either serous or purulent.

The artificial introduction, usually of air or nitrogen, into the pleural cavity is used in the treatment of certain diseases, or in diagnosis of certain chest conditions.

The treatment aims to collapse a diseased lung so as to evacuate pus contained in cavities in that lung

produced by such diseases as tuberculosis, lung abscess and bronchiectasis, and to place the lung at more or less complete rest. It is also used, in some cases, where fluid has been removed from the pleural cavity to aid in balancing the pressure within that cavity. Gas is injected at times to delineate a lung tumor, and aid in the diagnosis of that condition.

Special apparatus has been developed which allows of a flow of gas into the pleural cavity from a tank through a rubber tubing and the needle which has been inserted into the pleural cavity. This apparatus has attached a small manometer or gauge to determine the pressure contained within the pleural cavity. This manometer also determines, for the experienced individual, the site of the needle, if it has not been introduced far enough, or has been introduced too far and has penetrated the lung, resting perhaps within the lumen of a blood vessel where gas injection may cause serious results. The dangers, other than the injection of gas into the blood stream, are those which occur from shock. The tearing of adhesions may also occur and cause a spontaneous pneumothorax. Pneumothorax, in properly selected cases, has been of great value in the treatment of tuberculosis of the lungs.

B. G.

PNOM-PENH, the capital and chief town of Cambodia, French Indo-China, situated about 173 mi. from the mouth of the Mekong River; accessible by ocean-going steamers. Inland the Mekong and its tributaries afford a total of 875 mi. of waterways in the wet season and over 500 mi. in the low water season. A road now runs from Pnom-Penh to the famous old ruins of Angkor. The palace of the king of Cambodia and the administrative seat of the French resident are in the capital. Est. pop. 1930, 83,079.

PO, the largest river of Italy, rises in the Cotian Alps and flows eastward through Piedmont and Lombardy to the Adriatic Sea where it empties after a course of about 425 mi. In places in Lombardy, the bed of the river is higher than the surrounding country and inundation is prevented by a system of dikes. The chief affluents of the Po are the Dora Riparia, Dora Baltea, Sesia, Ticino, Adda, Oglio, Mincio, Tanaro, Trebbia, Taro and Panaro. The cities of Turin, Cremona and Piacenza are on the banks of the Po. Po is valuable for the fertility it affords to the soil. The river is open to navigation for about 350 mi. from its mouth.

POCAHONTAS (c. 1595-1617), Indian princess and heroine of a celebrated American tradition, was born about 1595, the daughter of Powhatan, a powerful Indian chieftain of Virginia. According to the traditional tale, Captain John Smith was captured by Powhatan's warriors in 1608, while engaged in exploration. He was about to be executed by his captors when Pocahontas intervened in the nick of time and saved his life. Grave doubt has been cast on the authenticity of this well-known story, due chiefly to the fact that it does not appear in Smith's earlier accounts of his explorations, and was not given in detail until 1624. Pocahontas, who seems to have had

always a friendly feeling toward the white colonists, was converted to Christianity, and in 1613 was christened "Rebecca" at Jamestown. A year later she married John Rolfe and in 1616 journeyed with him to England, where she was received with much interest and enthusiasm. Pocahontas died at Gravesend, England, Mar. 29, 1617, and was interred there. She left one son who, after living in England for several years, returned to Virginia.

POCATELLO, the second largest city of Idaho and county seat of Bannock Co. It is situated 135 mi. north of Ogden, Utah, on the Union Pacific Railroad. The fertile volcanic region has been developed by irrigation for diversified farming; mining and stock-raising are the other leading pursuits. Pocatello is an important distribution and railroad center and has a flour mill, potato-packing plants, wholesale houses, stock yards, machine shops and railroad shops. The approximate value of all manufactured products for 1929 was \$5,000,000; the retail trade amounted to \$9,911,004. The southern branch of the University of Idaho and Holy Cross School are located here. Pop. 1920, 15,001; 1930, 16,471.

POCKET, in mining, a cavity of irregular shape which contains ore. Also a swelling in a vein, a collection of alluvial gold in one spot, or a small body of rich ore. The receptacles, usually excavated in the rock, for storing broken ore or rock at various LEVELS in a SHAFT, are also called pockets. See also MINING, METAL; ORE DEPOSITS; PLACERS.

POCKET GOPHER, any member of the terrestrial rodent family *Geomys*, limited to North and Central America. They are distinguished by having in each cheek a fur-lined pouch formed by inversion of the skin; it does not open into the mouth, but is filled and emptied by the gopher using its fore feet. Its food is mainly roots and tubers, which it cuts to pieces, stuffs into its pouches and carries to its burrow. These rodents are nearly as subterranean in habit as moles, being often mistakenly so called, and work their way by teeth and claws in search of food just beneath the sod, at intervals throwing up hillocks of earth. Here and there they excavate permanent chambers where they store food in needlessly large quantities. Several species are exceedingly numerous throughout the western plains and in California, doing immense damage to crops and orchards. Costly measures for controlling these pests are necessary, some of which are aided by the Federal Government.

E. I.

PODOPHYLLUM. See CATHARTICS.

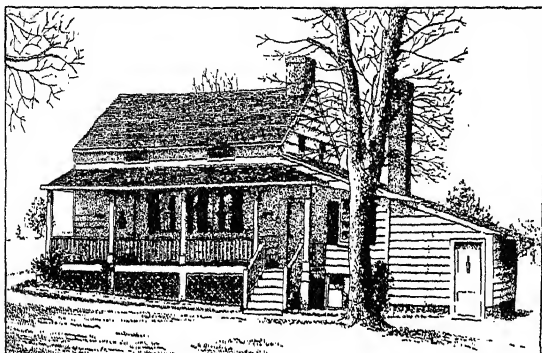
POE, EDGAR ALLAN (1809-49), American poet, editor, critic and writer of tales, was born at Boston, Mass., Jan. 19, 1809, the son of David Poe and Elizabeth (Arnold), actor and actress, who were playing in that city. From his father he inherited a tendency to tuberculosis and alcoholism. Left an orphan at the age of two, he was brought up by John Allan, a wealthy citizen of Richmond, Va., who took him to England, gave him a good education, but spoiled and pampered him. In 1826 Poe entered the Uni-

versity of Virginia, where he distinguished himself as a student, but which he left without taking a degree. He quarrelled with Mr. Allan, tried to get a start by publishing *Tamerlane, and Other Poems* in 1827; enlisted in the army under an assumed name; and in 1829 was reconciled with his foster father and published *Al Aaraaf, Tamerlane, and Minor Poems*. In 1830 Poe was appointed a cadet at West Point, but the restraint of the routine irked him, and he contrived to get himself dismissed in 1831. A rupture with his benefactor followed. He settled in Baltimore, Md., and in 1833 won a competition for a prize poem, with *The Coliseum*, also one for a prize story with *The MS. Found in a Bottle*. Mr. Allan died in 1834 without providing for Poe, and the latter, thrown on his own resources, took up literature as a profession, contributing to various periodicals.

In 1835 Poe's career as a critic began. In 1836 he married his cousin, Virginia Clemm, and they remained devoted to each other until her death in 1847. He moved from Baltimore to Richmond, to edit the *Southern Literary Messenger* in 1835, and in 1837 the Poes went to New York City, where Poe wrote for the *New York Quarterly Review*. In 1838 he published a novel, *Arthur Gordon Pym*, which was more successful in England than in the United States. In the same year he moved to Philadelphia, to become editor of the *Gentlemen's Magazine*, which in 1840 was merged with another periodical under the name of *Graham's Magazine*, Poe being retained as editor. His best tales were written at this time, notably *Ligeia*, and *The Fall of the House of Usher*. His first collection of stories, *Tales of the Arabesque and Grotesque*, was published in two volumes in 1839. *Murders in the Rue Morgue* appeared in *Graham's* in 1841, followed early in 1842 by *The Descent into the Maelstrom*, and in Nov. of the same year by *The Mystery of Marie Roget*. Shortly afterwards appeared *The Purloined Letter* and *The Premature Burial*. As editor of *Graham's*, Poe introduced ELIZABETH BARRETT BROWNING to American readers. In 1842 he resigned his editorship, and planned to establish his own magazine, *The Stylus*, but the plans came to nothing. In 1843 he lectured on poetry in Baltimore, and subsequently gave lectures in New York, Boston, Lowell and other places. In this same year he won a prize with *The Gold Bug*. The next year he moved to New York City, where he was associated with the *Saturday Museum*, and for a while with N. P. Willis's *Mirror*, leaving it after 6 months to take a position on the *Broadway Journal*, where he remained until 1846. *The Raven* was published in the *American Review* in 1845, and Poe became immediately famous. In 1846 he moved to Fordham, near New York, for his wife's health. She died the next year. *Ulalume*, 1847, was followed by *Eureka*, 1848; and in 1849, while on a visit to Lowell, he wrote *The Bells*. The same year Poe left Fordham for Richmond, where he again considered founding *The Stylus*. While on a trip to Philadelphia and Baltimore that autumn he was taken ill, and died Oct.

7, of inflammation of the brain in a Baltimore hospital. He is buried in that city.

Poe's writings are neither great in volume, nor in range of subjects; they are of unequal merit, but show power and originality. He is a pioneer in detective fiction and a certain kind of mystery story. Through the translations and ardent sponsorship of



POE'S COTTAGE AT FORDHAM

CHARLES BAUDELAIRE his genius was first appreciated in France. His vigorous analysis and the fecundity of his imagination, with his musical verse, love of the melancholic and macabre, make him an outstanding figure in American letters. *See also* AMERICAN LITERATURE; DETECTIVE STORY; MYSTERY STORY.

R. W.

BIBLIOGRAPHY.—*Works of Poe*, ed. by E. C. Stedman and G. E. Woodberry, 1914; G. E. Woodberry, *Life of E. A. Poe*, 1909; W. C. Brownell, *American Prose Masters*, 1909; Joseph W. Krutch, *Edgar Allan Poe*.

POET LAUREATE, in England, that poet who is appointed by the Prime Minister to the official position of Poet of the Realm, whose duty it originally was to compose odes in honor of the sovereign and on state occasions. Laureate, from the Latin *laureatus* (laureled), refers to the ancient custom of crowning heroes with laurel. John Skelton (d. 1529) styled himself *Poeta Laureatus*, but Ben Jonson (d. 1637) is generally considered the first laureate. He was succeeded by William Davenant, who was followed by John Dryden, the first to receive the office by letters patent, 1670. Dryden's successors were Thomas Shadwell (laureate from 1689 to 1692); Nahum Tate (1692-1715); Nicholas Rowe (1715-18); Laurens Eusden (1718-30); Colley Cibber (1785-90); William Whitehead (1758-85); Thomas Warton (1785-90); H. J. Pye (1790-1813); Robert Southey (1813-43); William Wordsworth (1843-50); Alfred Tennyson (1850-92); Alfred Austin (1896-1913); Robert Bridges (1913-30); and John Masefield (1930-). The laureate's salary varies; Dryden, for example, received £300 and a butt of Canary wine yearly; Tennyson £99 yearly, £27 of which was in lieu of the stipulated "butt of sack."

POETRY, that branch of imaginative literature written in **VERSE**. This definition, however, is open to criticism for the reason that although all poetry is written in verse, all verse is not poetry, but may

be nothing more than **DOGGEREL**. Poetry is exceedingly difficult to define, poets themselves being no better than others at describing the precise nature of their productions. One may look upon it as fiction in verse, a literary production in rhythmic language, or a composition resulting from intense inspiration and personal emotion.

One of the remarkable facts about poetry is that it is practiced by the primitive peoples as well as by the most highly cultured and civilized. It preceded **PROSE** in all countries, and is so prevalent and so ancient a form of literature that it is scarcely any exaggeration to say that, while a poem mirrors the soul of the individual who writes it, the bulk of a nation's poetry reflects its collective soul. Its innate characteristic, apart from versification, is that it is addressed to the emotions rather than to the intellect; to intuition and not to reason; to the imagination and not to logic. Poetry generally has no aim beyond moving the emotions and awakening memories in the human heart. To this end it employs musical language and a richness of imagery far beyond the scope of the best prose. This musical quality is chiefly attained by a grouping of words to form a rhythmical pattern, and this rhythm is in its turn the result of an arrangement of sounds, of which the ear, hearing them one by one, retains the preceding while listening to the later ones. This arrangement of sounds involves the division into regular measures of the syllables of a succession of words. This division may be based on the stress on certain syllables, as in English and German poetry; on their length, as in Greek and Latin; or on their number, the last being the general rule in French poetry.

But excellence in the use of these technical rules of versification is not sufficient for the creation of true poetry. It must possess poetical feeling, a quality which almost defies definition, since it is something that is only sensed and not seen, touched, or heard. But if, in reading or hearing verses, emotions, perhaps acute, perhaps vague, are stirred, and memories rise to the surface of consciousness, then it may be assumed that poetical feeling is present and is strong in proportion to the strength of these emotions and memories. It is this poetical feeling that LAMARTINE had in mind when he said that the poetical art was "the incarnation of the most intimate in the heart and divine in the thought of man" and when he asked whether "as long as man does not perish is it possible for his highest faculty to perish?"

Poetry is divided into three main branches. The first and most ancient is the **EPIC**. Epic poetry is narrative in form and sings in a noble and elevated style, the deeds of heroes, warriors, the great or the good. The Homeric poems (*see* **ILIAD**; **ODYSSEY**) belong to this division of poetry, as do also the German *Nibelungen*, the French *chansons de geste*, Milton's *PARADISE LOST*, the Ossianic poems of Macpherson and Victor Hugo's *Légende des Siècles*. The instinct to demand a story being inborn in the human race, it is natural that this type of poem should be the

earliest and the chief kind in vogue among the primitive peoples.

The next main branch is the LYRIC. While epic poetry demands a large canvas and concerns itself chiefly with the external life of the personages of the poem, lyric poetry is essentially individual, personal and subjective. It tells exclusively of the intimate personal emotions of the poet, whether of his grief and suffering or of his happiness and ecstasy. England particularly abounds in lyrical poets, of whom BURNS, SHELLEY and TENNYSON may be cited as among the highest examples; and Germany has the exquisite lyrics of HEINRICH HEINE. In France there are the medieval VILLON and the 19th century DE MUSSET.

The third main branch is dramatic poetry. (*See also* DRAMA.) This reproduces in versified form scenes in imitation of life, not in narrative but in acting form, the story being carried on by the personages created by the poet for that purpose. It is a much younger form than the epic, since dramatic poetry in a highly developed type demands for its presentation knowledge of the art of mimicry or acting and, as in the Greek dramatic poems, of music. Dramatic poetry is of two main kinds—TRAGEDY and COMEDY—and the ancients seem never to have thought of drama in prose form. It was the Spanish who first freed themselves from what many consider a shackling restriction, artificial to the highest degree, since in real life, which the drama seeks to mirror, no one speaks in any form but prose. SHAKESPEARE combined both, although he retained poetry for the expression of all philosophical, noble, beautiful or elevated thought. *See also* ENGLISH, FRENCH, GERMAN, ITALIAN, GREEK, LATIN LITERATURE.

BIBLIOGRAPHY—Aristotle, *De Arte Poetica*, E. C. Stedman, *Nature and Elements of Poetry*, 1892; W. J. Courthope, *History of English Poetry*, 1895-1905; *The Cambridge History of English Literature*, 1907-17; W. A. Neilson, *Essentials of Poetry*, 1912; W. P. Ker, *The Art of Poetry*, 1923.

POGGIO (1380-1459), Italian scholar, whose full name was Gian Francesco Poggio Bracciolini, was born at Terranuova, near Florence, Feb. 11, 1380. He studied Latin and Greek and became a skilled copyist of manuscripts. About 1403 he became a secretary in the Roman curia where classical studies absorbed his attention so completely that he took no interest in the bitter conflicts of popes and cardinals raging around him. He unearthed and restored many masterpieces of ancient literature and at Langres discovered Cicero's *Oration for Caecina*. He wrote moral essays, satires, a *History of Florence*, and was a fiery, combative orator. Late in life he was appointed historiographer of the Republic of Florence. Poggio died at Florence, Oct. 30, 1459.

POGONIA (*P. ophioglossoides*), a handsome wild orchid found widely in eastern North America and in Japan, called also rose pogonia and snake-mouth. It grows in meadows and swamps from Newfoundland to Minnesota and southward to Florida and Texas. The slender unbranched stem, 8 to 15 in. high, rising from a fibrous root, bears from one to three lance-shaped leaves and one or occasionally

two large, fragrant, somewhat nodding, rose-colored flowers with a conspicuously bearded lower lip. The similar spreading pogonia (*P. divaricata*), found in the southeastern states, lacks the beard or the lower lip.

POGROM, Russian for destruction or devastation. Anti-semitic sentiment arose in Russia as early as the 12th century, and under the Empire, especially during the reigns of both Alexander III and Nicholas II, the Jews were subjected to measures of cruel oppression. In 1881, their area of residence, called "rayon," was restricted to Poland and the western provinces. In 1886 they were excluded from all government posts and most of the professions. In their local universities not over ten per cent and at those of Moscow and Leningrad only five per cent of the students enrolled could be Jews, and their acquisition of real estate was forbidden. The police authorities unquestionably provoked popular hostility against the Jews as a vent for the dissatisfaction arising from political disabilities. In 1905 Plehve, then Russian Minister of the Interior, inspired a brutal pogrom at Kishinev in Bessarabia which aroused widespread indignation throughout the world, and especially in the United States. In the course of the revolution of 1905, reactionary elements in control of the Russian police repeatedly organized armed attacks against the Jews, particularly in Odessa, but also elsewhere throughout the Empire, and after the revolution in 1905 persons who had participated in such pogroms were actually pardoned by Nicholas II. The term pogrom, signifying any deed of violence against the Jews, has more recently been applied to Polish attacks upon the Jewish minority in 1919 and to similar reprehensible outbreaks of popular sentiment in both Hungary and Rumania. S. H. C.

POINCARÉ, RAYMOND (1860-), French statesman and President of France, was born at Bar-le-Duc, Aug. 20, 1860. Son of a distinguished scholar, and brother of a noted mathematician, he himself made a brilliant record as a law student, was admitted to the Paris bar and in 1887 entered the Chamber of Deputies. He became minister of public instruction in 1893, was minister of finance 1894-95, vice-president of the Chamber 1895-97, and again held office for a brief period in 1906. He was elected to the Senate in 1903 and to the French Academy in 1909.

Leader of the Nationalists in France, Poincaré served as prime minister and minister of foreign affairs, 1912-13, and during that time sent LOUIS LIAUTEY to Morocco to establish France firmly in that country, strove to localize the Balkan wars, and to prepare France for the general conflict which he clearly saw was coming. Thus, he urged a bigger fleet program and was one of those responsible for the agreement with England by which the French fleet was concentrated in the Mediterranean, as well as for the convention with Russia providing for the cooperation of the French and Russian navies and their chiefs of general staff.

Elected President of France, Jan. 17, 1913, he proved to be more than the mere figurehead that French presidents are apt to be. He pushed forward the three years military service law, and was influential in sending Delcassé to Russia to cement the Franco-Russian alliance. In July 1914, he visited the Czar himself with the same end in view. During the war, he worked for the retrocession of Alsace-Lorraine, which, indeed, had been the object of his hopes since boyhood, and, in 1917, he proved the sincerity of his patriotism by appointing his political opponent, Clémenceau, premier of France.

His term as President ended in 1920. In January 1920, he was chairman of the Reparations Commission. Having overthrown Briand in January 1922, because Briand sought to come to terms with England on the German reparation question, he became himself prime minister and minister of foreign affairs once more 1922-24. He insisted that Germany should pay her reparations obligations, and, when she failed to do so, he occupied the Ruhr with French troops 1923. In 1925 he overthrew Herriot who had leaned toward the Socialists, and was recalled as premier in 1926 to restore order to French finances, with the result that, in an incredibly short time, France was on the road to prosperity again. Serious illness caused him to resign office in January 1929. He commenced the publication of his memoirs in 1926 under the title *Au service de la France*. He also wrote *La victoire et la paix*, 1922, and *Les origines diplomatiques de la guerre*, 1921. C. W. P.

POINCIANA, ROYAL (*Delonix regia*), a strikingly handsome, broad-topped tree of the pea family. It is a native of Madagascar extensively planted for ornament in southern Florida, southern California and throughout the tropics. It grows 20 to 40 ft. high with wide spreading branches bearing much divided leaves, 1 to 2 ft. long, clusters of very showy, bright scarlet flowers, which bloom most of the summer, and flat, narrow pods, sometimes 2 ft. in length.

POINSETTIA (*Euphorbia pulcherrima*), a handsome tree of the spruce family cultivated in numerous forms for its highly ornamental, bright scarlet floral leaves, very popular for Christmas decorations. It is a native of tropical Mexico and Central America, extensively grown in greenhouses in the North and planted in the open in the South. In cultivation the plant grows from 2 to 10 ft. high, bearing large, deep green leaves and greatly enlarged, brilliantly colored floral bracts surrounding numerous inconspicuous flowers. The poinsettia is usually grown each year from cuttings, which require special treatment in order to produce bloom at the desired time and to form stems of desirable length.

POINT, a geometric element conceived as position resulting from the intersection of two lines. It has no magnitude but has position.

POINT DE GALLE. See GALLE.

POINT PELEE PARK, a Canadian national park, established May 29, 1918; area 6.01 sq. mi. Situated at Laemington in western Ontario, Point Pelee, which

juts out into Lake Erie, is the most southerly extension of Canada. The flora and fauna are unique and as it is the northern limit for many migratory birds it has been set aside as a bird reserve. The park has been developed as a government recreational area and is a popular summer resort.

POINTS OF THE COMPASS. See COMPASS.

POINT SYSTEM, a method of identifying type sizes in printing. Printing was nearly 300 years old before a Frenchman proposed a unit basis for the standardization of type sizes, and it was 150 years later that the idea gained practical acceptance in the United States. Early type founders named their different sizes, but the equivalent product of different concerns did not correspond. The result was confusion in any shop that patronized more than one founder. After the Chicago fire the firm of Marder Luce & Co., whose plant was destroyed by the fire started to make point system type. A decade later the system was adopted by the association of founders.

The simple table of the point system is: 12 point make one pica; 6 picas make one inch (approximate). The value of the point is, then, about 1/72 in. (actually 0.01388...). Every type body size is a multiple of this unit. Larger distances, such as length on line or column, are measured in picas. An em is a set or line-wise unit of distance the equivalent of the type body; e.g., an 8-point em measures 8 points set. In 12-point type it is equal to a pica, and is often incorrectly used for that term. See also TYPE, PRINTING. E. W. P.

POISON ASH, a name sometimes applied to a species of SUMACH (*Rhus Vernix*) with highly poisonous foliage. See POISON IVY.

POISONING. See ANTIDOTES; DERMATITIS; FOOD POISONING; GASES AND ATMOSPHERES, INJURIOUS; SNAKE BITES; PARALYSIS; TOXICOLOGY.

POISON IVY, the name commonly given in North America to several shrubby species of SUMACH (*Rhus*), all parts of which are more or less poisonous to the touch. While they are mostly low shrubs one sometimes becomes a small tree. They bear dark green leaves, usually of three leaflets, inconspicuous greenish-yellow flowers and a whitish fruit (drupe) containing a small, bony stone. All are popularly called poison ivy but are also known by various other names. The common poison ivy (*R. Toxicodendron*), the most widely distributed species, grows from Nova Scotia to British Columbia southward to Oregon, and east of the Sierra Nevada extends southward to Arizona, Mexico, Florida and Bermuda. In many parts of its range it is a low straggling shrub, but frequently develops into a stout woody vine climbing high trees. The dark green leaves are composed of three ovate, pointed, sometimes slightly toothed leaflets.

The poison sumach (*R. Vernix*), known also as poison elder and poison dogwood, one of the most dangerous plants of North America, grows in swamps from Quebec to Minnesota south to Florida and Texas. It is a shrub or small tree, sometimes 25 ft. high,

with ashlike leaves of 7 to 13 entire leaflets. The acrid juice, which turns black on exposure, may be utilized as a lustrous, durable varnish.

The southern poison oak (*R. quercifolia*), found in dry woodlands from New Jersey to Georgia and Texas, is a low shrub with leaves of three irregularly lobed or notched, velvety-hairy leaflets. The western poison oak (*R. diversiloba*) is found from Washington and Oregon southward throughout California to Mexico. It is an erect, sometimes climbing shrub, 4 to 8 ft. high, with leaves of three variously lobed leaflets in appearance somewhat resembling small oak leaves. In California poison oak is more widely diffused than any other shrub. While the foliage is



COURTESY U S DEPT OF AGRICULTURE

POISON IVY

Left, spray showing rootlets Right, fruit

highly poisonous to many persons, the honey made from the flowers contains no poison.

Ivy poisoning is caused by a non-volatile oil present in the sap exuded from the surfaces of the plants. Susceptible persons may be poisoned only by contact with the plant or through objects, as clothing, which have been in contact with it. A. B. J.

Ivy Poisoning. The poison is not found in the plant hairs nor pollen, but is confined entirely to the sap. It is necessary to injure the leaves or stems to cause the poison to come to the surface. This is true in winter as well as in summer. The poison, if not a resin, is at least intimately mixed with a resin. It is a clear amber-red, sticky, thick, non-volatile liquid which floats on water. This sticky substance will adhere to the skin like pitch and is as difficult to remove.

The poison may penetrate the skin by means of the sweat glands, the oil glands, the hair follicles, or even

the surface of the skin itself. In from twelve hours to a week, a reddening and itching is noticed. The poisoning may never be more severe than this or it may cause blisters, which may break and allow the serum to run freely over the surface. After about a week this condition disappears and the injured skin peels off. The poisoning is most often experienced between the fingers, on the back of the hands, on the fore arms, or on the face. Poisoning seldom takes place in portions of the body protected by hair. The inside of the hands and soles of the feet are seldom poisoned because of their thick covering of skin. The ears may swell and the eyelids may puff up. The skin changes are not easily distinguished from other skin rashes. If a person has been in a locality where poison ivy grows, it is likely that poison ivy is the cause. The distribution of the blisters on the skin is generally in stripes or patches caused by contact with the plant or scratching with the hand.

McNair has discovered that iron (ferric) chloride, when added to poison ivy sap, immediately causes a black precipitate to form. Both precipitate and solution are non-poisonous. A mixture of half grain alcohol and half water containing five grams of ferric chloride per 100 c.c. of liquid when allowed to dry on the human skin, will act as a prophylactic. This action will prevent injury to the most highly susceptible individuals. After the exposure of persons not previously made immune by the application of ferric chloride, it is recommended that the iron solution be applied to all skin areas that itch within 12 to 24 hours after poisoning takes place. Immediate application of grain alcohol, which might be on hand, or even soap and water, if used in abundance, will help remove the sticky poisonous patches. J. B. McN.

BIBLIOGRAPHY James B. McNair, *Rhus Dermatitis*, 1923.

POISON OAK, a name given to certain sumachs (*Rhus diversiloba*, *R. quercifolia*) with oaklike poisonous foliage. See POISON IVY; SUMACH.

POISON SUMACH, a name given to several species of SUMACH (*Rhus* sp.) which bear leaves sometimes very poisonous to the touch. See POISON IVY.

POITIERS, a town in central France, especially rich in ancient churches, one of which, the 4th century Baptistery St. Jean, is the oldest Christian edifice in the country. The Cathedral of St. Pierre, begun in 1162, was in the main completed in the 12th and 13th centuries. It was built largely at the expense of Henry II, King of England, and his Queen, Eleanor of Aquitaine; the façade and the larger part of the two towers were added in the 14th century. The church contains magnificent stained glass of the 12th and 13th centuries; the oldest window, that of the Crucifixion, is especially beautiful. The choir stalls were carved in 1235-57, and with one exception are the only stalls in France which go back to that period. The Church of Notre Dame La Grande is a fine Romanesque structure with a nave and choir of the 11th century, and a richly sculptured 12th century façade. Ste. Radegonde, of the 11th and 12th centuries, is another noteworthy example of the An-

gevin style. Other celebrated churches are St. Hilaire, 10th and 11th centuries, and the 11th century St. Moutierneuf. The Palais de Justice occupies the 14th century castle of the Counts of Poitou, lords of Poitiers. Modern Poitiers is the capital of the department of the Vienne. Pop. 1931, 41,546.

POITIERS, BATTLE OF, 1356, the second decisive battle in the HUNDRED YEARS' WAR. (See also CRECY, BATTLE OF; AGINCOURT, BATTLE OF.) With 8,000 men the Black Prince proceeded on a raiding foray into the province south of the River Loire. At Poitiers, he was intercepted by a French army at least four times as large as his own. The French King, John, demanded the surrender of the Black Prince, which the English refused. In the battle which ensued the English were victorious, the French losing 8,000 on the field, 3,000 in the retreat and 2,000 men-at-arms as prisoners, besides numerous nobles. King John himself was taken captive and held for heavy ransom.

POJOAQUE, a small pueblo and tribe of the North American Indian Tanoan linguistic stock. The pueblo is situated on a small eastern branch of the Rio Grande about 18 mi. northwest of Santa Fe, N.M. It was abandoned following the Pueblo Rebellion of 1680 and 1696, but was later resettled, becoming a mission station. Since the beginning of the present century it no longer exists as a Tanoan pueblo, but is occupied by Mexicans.

POKAGON PARK, a park of 700 acres in Steuben Co. in the extreme northwest corner of Indiana, established in 1925. The park has 2¼ mi. of shoreline on Lake James. Trails lead through woodland and rolling meadow country. Pokagon is a popular center for winter sports.

POKEBERRY (*Phytolacca americana*), a strong-smelling perennial herb of the pokeweed family known also as poke, pocan, skoke, pigeon-berry and garget. It is a native of eastern North America from Maine to Minnesota southward to Bermuda and Mexico; it is also extensively naturalized in southern Europe and various other parts of the world. The smooth fleshy stem, 4 to 12 ft. tall, rises from a large poisonous root. The numerous branches bear lance-shaped leaves, sometimes a foot in length, long-stalked narrow clusters of whitish flowers on reddish stems, and juicy dark purple berries. Young tender parts of the plant, always excluding the root, are eaten like asparagus. The berries and especially the root are used in medicine.

POKER, a card game almost invariably played for stakes. There are many variations, draw poker, jack pots and stud poker being the most popular. Using a full deck, the players cut for deal. The one turning the highest card deals first, the deal then going to each in turn and moving to the left. Five cards are dealt each player, one by one. In draw or straight poker every player puts into the pot an agreed-upon stake called his ante. The player at the dealer's left, called the age, then puts any stake he wishes into the pot and the other players in turn either put in an

equal stake or drop out. Those who have thus bought the right to draw cards discard such as they do not want, and the dealer gives them enough more to make up five. Whether a player stays in and draws cards depends on whether he thinks he can improve the hand originally dealt him.

After all those staying in have drawn cards, the age then bets any amount he wishes within a limit previously agreed upon. The next player may drop out, equal the bet and call or raise the bet. The next player has the same choice. This betting goes around the table until all bets have been called, or until all have dropped out except one player whom the others have refused to call. Such a player wins all stakes in the pot and does not have to disclose his hand. If one or more players have called, the hands of these players are placed on the table and the highest hand takes the pot.

In jack pots, no player can begin the betting unless he holds a pair of jacks or better in his original hand. If no player has these and can open, all put in a new ante and the cards are dealt again. In stud poker, the first card around, or in two-card stud, the first two cards dealt, are placed face down and the remaining cards face up. Bets are made after each deal.

For rules and values of hands, see R. J. Foster, *Practical Poker*, Hoyle's Games.

POKER PLANT (*Kniphofia Uvaria*), a showy garden ornamental of the lily family, called also torch-flower. It is a native of South Africa, with various hybrid forms in cultivation. The plant rises from a short upright rootstock, bearing numerous long-pointed root leaves, 2 to 3 ft. in length, and a tall flower-stalk ending in a dense poker-like spike of drooping flowers, the uppermost usually bright scarlet and the lower ones yellow, blossoming in late summer.

POLA, a port on the Adriatic Sea, capital of the province of the same name on the western coast of Istria, in northeastern Italy. Formerly belonging to Austria-Hungary, it is now the headquarters of the Italian Adriatic fleet and is strongly garrisoned. Before the harbor lie the Brioni Islands, incorporated with the city. Pola is the seat of a bishop, who is also the incumbent of the see of Parenzo. The 15th century cathedral was almost totally destroyed by fire in 1923, and was enlarged and rebuilt five years later. The city hall, built about 1300, occupies the site of school. There is a seaplane port and a radio station. The city hall built, about 1300, occupies the site of a temple of Diana. Notable remains of classic architecture are the temple of Augustus Caesar, built 2 B.C.-14 A.D., and the triumphal arch, 30 B.C. The most impressive Roman monument is the amphitheater built to accommodate more than 20,000 people. Fish are canned here and there is a State tobacco factory, but the chief occupation is trade. Pop. 1931, 55,559.

POLABIAN, an extinct Lechic language of the West SLAVIC linguistic group spoken until about 1750 in the lower area of the Elbe River. The last Slavs who employed it were the Drevanians in the District of Lüneburg (Province of Hanover), where they

arrived in the 9th century from the Altmark, occupying the territory of the Saxons. The literary documents of Polabian, which is closely related to KASHUBIAN, consist chiefly of several glossaries of inferior quality.

BIBLIOGRAPHY—A Schleicher, *Lauf- und Formenlehre der polabischen Sprache*, 1871; P Rost, *Die Sprachreste der Diewano-Polaben im Hannoverschen*, 1907.

POLAND, a republic of Europe, created in 1921 out of territories which, since the Congress of Vienna in 1815, had been in the possession of Russia, Austria-Hungary and Germany. Poland comprises an area of 149,958 sq. mi. and is bounded on the north by Latvia, Lithuania and East Prussia, on the west by Germany, on the south by Czechoslovakia and Rumania and on the east by the U.S.S.R. A narrow strip of Polish territory extends to the Baltic and gives the country a coastal line of 86 mi.

Surface Features. Uniformity is the chief characteristic of the surface features of Poland. Except on the Carpathian foothills in the southwest, the country presents a plain of gently rolling slopes and alluvial stretches broken by occasional sandy flats and mashes. In the northeast and southwest there are extensive forests. The highest point of land is Lysa Gora, in the southwest. It reaches a height of about 2,000 ft. above sea level. The central plain of Poland, which extends from the foothills of the Carpathians to the Baltic, is drained by the Vistula River. The headwaters of the Vistula are in the southwest. The river flows northward, passing by Warsaw, Plock and Bremberg, and reaching the Baltic Sea near the free city of Danzig. The main tributaries of the Vistula are the Pilica, the San, the Wierpz and the Bug. During heavy rains the current of this great river swells and serious floods result even near Cracow, not far from the sources. The River Dniester, which empties into the Black Sea and forms the boundary between Russia and Rumania, has its source in Polish territory, in the southeast section of the country. In the northeast part of Poland there are a number of smaller rivers and several lakes. The largest lake in the country is Narocz, having an area of 31 sq. mi.

Population. According to figures issued by the Central Statistical Bureau of Warsaw in 1931, Poland had a population of 31,757,448. The bulk of it, nearly 70%, is Polish. Ruthenians and Ukranians form the largest minority group. They represent about 15% of the total inhabitants. There are over 2,000,000 Jews. The German and White Russian groups comprise more than 1,000,000 each, while the Lithuanians number close to 100,000. Twenty-five per cent of Poland's population is urban. The estimated population of the larger cities in 1930 was as follows: WARSAW, capital, 1,109,478; Lodz, 606,980; LEMBERG, 240,725; Posen, 248,000; VILNA, 201,925; Cracow, 210,632; KATOWICE, 128,270.

Education and Religion. Education is compulsory in Poland for all children. According to the statistics for the school year 1928-29 there were 27,933

elementary schools with 3,500,000 pupils, 777 secondary schools with 203,000 pupils and 868 teachers' seminaries and schools with 56,000 pupils. There were also 1,005 technical, commercial, manual training and agricultural schools with 150,336 students. The institutions of higher learning had an enrollment of 43,300 for 1928-29. Of the six universities the University of Cracow, established 1364, is the oldest and best known. Other important institutions include two national polytechnical institutes, the Mining Academy of Cracow, the Academy of Commerce and the Higher School of Agriculture in Warsaw, two Academies of Fine Arts, five Conservatories of Music, and schools of dentistry, veterinary medicine, foreign trade and political science.

Roman Catholicism is the predominant faith of the people, about two-thirds belonging to this church. The next largest groups are the Greek Catholics and the Russian Orthodox, the former representing 11% and the latter 10½% of the total population. There are more than 1,000,000 Protestants. By a concordant concluded with the Pope in 1924, Poland is divided into five Catholic provinces, i.e., Posen, Vilna, Lemberg, Warsaw and Cracow; is composed of 20 dioceses and has two cardinals, four archbishops and 30 bishops. Greek and Ruthenian Catholics are governed by one province in Lemberg, which includes three dioceses. Armenian Catholics, forming but a fraction of the population, are governed by an archbishop at Lemberg. The total number of Catholics is over 21,000,000. The Greek Orthodox Church is divided into five dioceses and headed by the Metropolitane of Warsaw and the synod of bishops. There are 17 Orthodox monasteries in Poland. The Jewish community has no uniform organization.

Production and Industry. Agriculture is the mainstay of Polish life, about two-thirds of the population living on the soil. Of the total area 48.6% is arable, 34.1% forests, 6.7% pasture, 10.2% meadowland, while other cultivated and fallow land amounts to 10.4%. The larger portion of the arable land is owned by the peasants in small holdings. There are still estates, but their size is limited to from 150 to 1,000 acres, depending on the districts in which they are located and on their proximity to large towns. From 1919 to 1927 more than 3,000,000 acres of arable land were parceled out of the estates into small holdings.

The principal crops of Poland and their yield in metric tons in 1929 were as follows: wheat, 1,792,476; rye, 7,009,765; barley, 1,659,769; oats, 2,953,904; potatoes, 31,749,769; sugar beets, 4,970,388. In the same year the country possessed 9,056,749 cattle; 4,046,737 horses; 4,828,641 pigs; and 2,523,493 sheep. In mineral wealth Poland ranks very high. Her extensive industries are based upon her ample supply of coal. Other important mineral products are crude petroleum, natural gas, salt, potash, iron ore, steel, zinc, lead and silver. The output of some of these minerals in 1929 in metric tons was: black coal, 46,236,000; lignite coal, 74,000; coke, 1,858,000; steel, 1,380,

000; lead, 29,000; potash, 352,000; salt, 407,000; the total production of crude oil in the same year reached 4,722,823 bbls. At the beginning of 1930 there were in the country 2,925 oil and gas wells in exploitation.

The textile industry is the most important in Poland. The principal textile mills are located at Lodz, Bialystok and Bielsk. In the latter two cities are centered the woolen mills, while Lodz and the surrounding manufacturing towns are engaged in the production of cotton weaves. Zyrardow, near Warsaw, is a linen center. Flax, hemp and silk products are also manufactured in large quantities. Over 150,000 persons are employed in the textile industry alone. The workers are skilled weavers and designers. In 1929 there were 775 textile mills throughout Poland.

The sugar and distilling industries are also of great importance. In the production of sugar Poland ranks fourth in Europe, being surpassed only by Germany, France and Czechoslovakia. In 1929 there were 71 sugar refineries and the output was 617,000 tons. Oil refining of late is developing into a considerable enterprise. In 1928 there were 26 refineries employing some 5,000 workmen. Other significant Polish industries include brewing and tanning and the manufacturing of paper, cement, glass and chemicals. In 1929 there were 679 woodworking plants and 744 foundries and metal factories.

Transportation and Trade. Polish commerce and industry are hampered by inadequate transportation facilities. Poland, being constituted of territories formerly belonging to Germany, Russia and Austria-Hungary, inherited from these countries railways differing in structure and operation. The Russian railway, for example, is of wider gauge than those of the other countries. Poland had to coordinate into a single national system these railways, which were, moreover, badly in need of repair after neglect during the World War. On Dec. 31, 1929, Poland had 15,117 mi. of railways open to traffic. All of the lines are owned and operated by the state. Plans are being perfected by the government for a vast improvement of the internal communications and waterways, which already serve a large share of the commercial traffic of the country but which need dredging and other improvements. Although Poland had access to the free port of Danzig, the outlet proved inadequate and in 1924 she began building the port of Gdynia. The commercial traffic through this port has been steadily growing. In 1930 a total of 2,238 vessels of 2,029,822 tonnage cleared the harbor. In that year the Polish government acquired an interest in the Baltic-American Steamship Line, the present Gdynia American Line, and established transportation and shipping service with New York. Poland's merchant marine in 1930 consisted of 30 vessels of 52,688 gross tonnage. On Jan. 1, 1929 a new airline company was formed for the purpose of taking over all commercial airlines. In 1931 it operated eight lines with numerous ramifications, and the Warsaw, Cracow, Lemberg, Posen, Katowice, Lodz and Bromberg possessed fully equipped landing fields. Connections with European

air routes have been made. The telegraphic and telephone systems are owned and operated by the State.

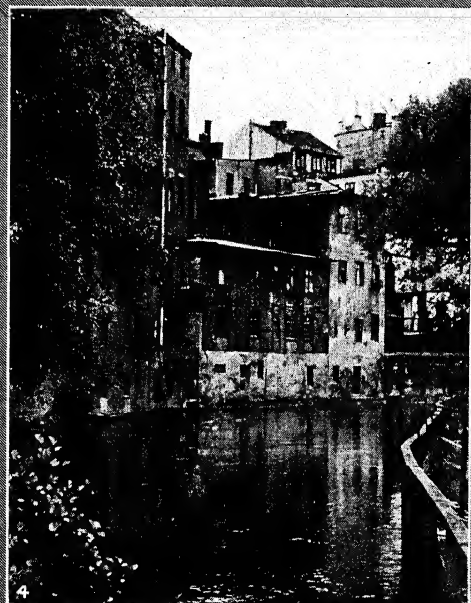
For several years immediately after the establishment of the republic Polish trade was in a confused and precarious state. The extensive markets which the Russian provinces offered for the textile industry of Poland before the World War were suddenly closed, and this industry faced a serious crisis. Gradually, however, the buying power of the Polish peasant improved and new foreign markets were developed. By 1924 Polish trade was once more on a normal basis. Poland is now one of the outstanding commercial and industrial countries of Europe. The foreign trade is chiefly with Germany; in 1929 the imports were 27.3%, the exports 31.2%. There is considerable commerce with the United States, Great Britain, Austria, Czechoslovakia and the Netherlands.

The principal exports are timber and coal, and sugar, barley, meat, dairy products, eggs, poultry, pigs and other animals, fodder, petroleum and textiles are also important. The imports include cotton, machinery, wool, iron and steel products, dressed hides, electrical equipment, fertilizers, animal fats, copper and copper products and tobacco. In 1929 the total value of the imports was 3,110,979,000 *zlotys* and of the exports, 2,813,359,000. In 1930 the imports decreased to a total of 2,245,973,000 *zlotys* and the exports to 2,433,244,000.

Finance. The monetary unit of the Polish Republic is the *zloty*. It was introduced in 1924 and was then equal to one gold franc. By the monetary reform of 1927 par value of the *zloty* was changed to 43.382 to the pound sterling or 8.9141 to the dollar. There are gold coins in circulation of 25.50 and 100 *zloty* denominations, and silver coins of two and five *zlotys*. Nickel and bronze are used for coins of smaller denominations. The bank notes are of 10, 20, 50, 100 and 500 *zloty* denominations. They are issued by the Bank of Poland, which was founded by Act of Parliament and opened in Apr. 1924. This bank has the sole privilege of issue until Dec. 31, 1944. On Dec. 31, 1930, there were in circulation 1,599,618,138 *zlotys* in bank notes and metal currency. The treasury notes have been withdrawn from circulation and supplanted by the Bank of Poland notes. At the beginning of 1930 there were in Poland 51 principal banks with an aggregate capital of 246,853,000 *zlotys* and total deposits of 817,742,000.

The national budget for the fiscal year 1930-31 as passed by Parliament proposed the expenditure of 2,940,922,000 *zlotys* against an anticipated revenue of 3,038,737,000. The principal items of expenditure are for military affairs, education and debts service. On Dec. 31, 1928 the national indebtedness of Poland consisted of 327,214,000 *zlotys* of internal and 3,680,794,000 *zlotys* of external debts. The principal creditor nations are the United States and France. On Jan. 1, 1930, the total public debt, internal and external, was 4,211,530,000 *zlotys*.

Government. Poland was proclaimed a republic by the Poles themselves in 1918, immediately after



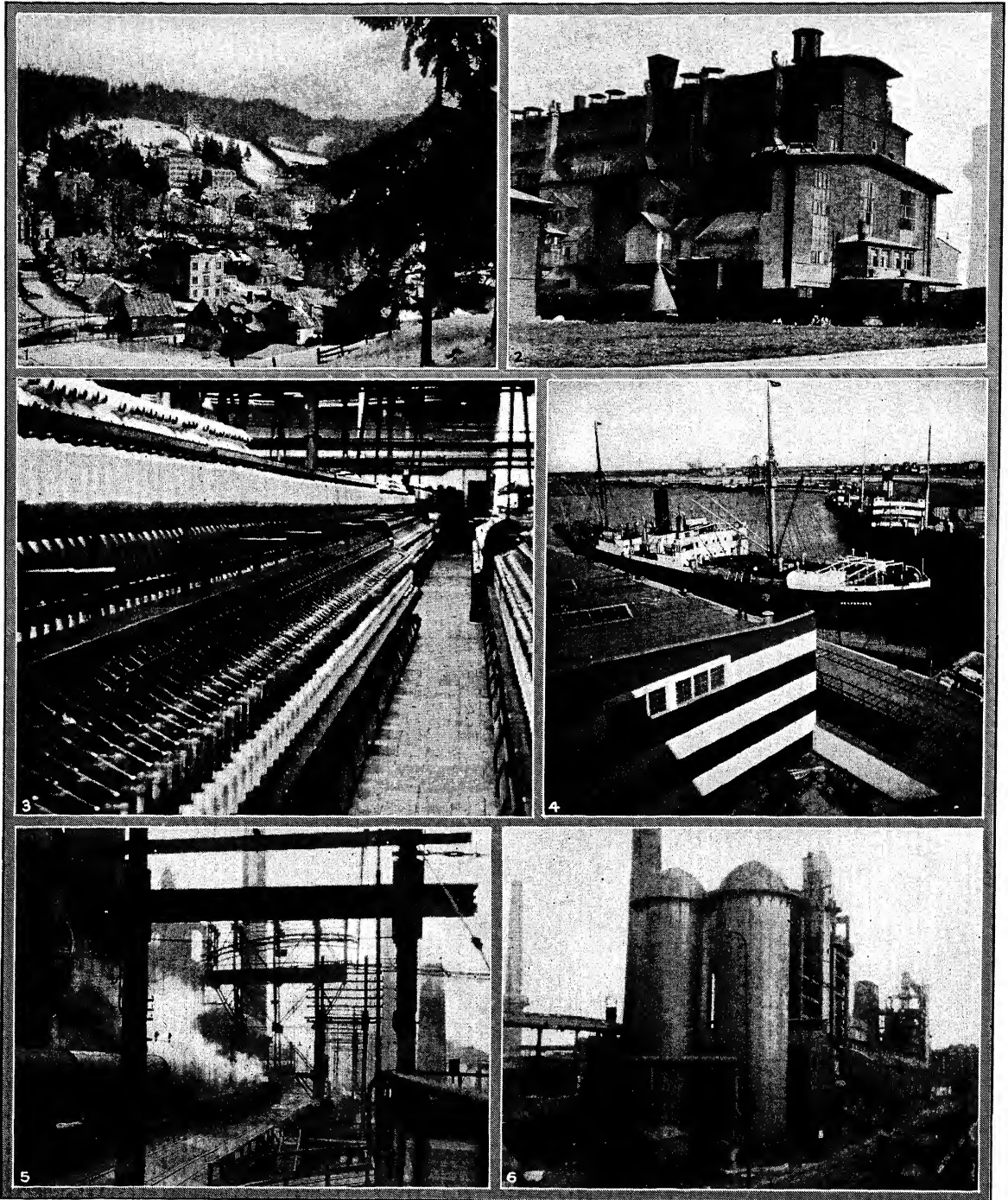
COURTESY CONSULATE GENERAL OF POLAND

SCENES IN THE COUNTRYSIDE OF POLAND

1. Section of the "King's Canal," Polesie Co. 2. View from Mt. Giewont in the Polish Tatras. 3. Mountaineer, or "goral," of the Tatra Mountains. 4. Canal of Byd-

goszcz, one of the larger towns. 5. Peasant church procession, Corpus Christi Day. 6. Peasant girls of the Lowicz District wearing the characteristic native costume.

POLAND



COURTESY CONSULATE GENERAL OF POLAND

MODERN INDUSTRIAL POLAND

1. General view of Krynica, where the international hockey matches are held. 2. Chemical works at Chorzow, upper Silesia, a factory founded by President Ignace Moscicki.

3. Artificial silk factory at Tomaszow. 4. Canal in the port of Gdynia. 5. Steel plant in Polish Upper Silesia. 6. The "Huta Pokoja" steel foundry in Polish Upper Silesia.

the defeat of the Central Powers. It was recognized by the Treaty of Versailles in 1919. The new Polish constitution, fashioned in part after the old Polish constitution of 1791 (before Poland was partitioned among Russia, Prussia and Austria-Hungary) but largely after modern models, was adopted on Mar. 21, 1921. It provides for a legislature of two chambers and for universal suffrage. The chambers are the Senate and the Diet, or *Sejm*, the former consisting of 111 members and the latter of 444, are elected for five years by popular vote. In the senatorial elections only persons who have reached their thirtieth year are privileged to vote. In the elections of the *Sejm* deputies all franchised persons over 21 years of age have the right to vote. The Senate may alter or reject a bill passed by the Diet, but if repassed by the Diet by a majority of 11/20 the President must publish it as law. The constitution itself can be amended by a two-thirds majority of both chambers. The constitution, which contains an elaborate bill of rights, grants wide liberties to the non-Polish citizens of the state. They are allowed the right to foster their national traditions and institutions and to develop their national tongues. The language rights of the Ruthenians, Lithuanians and White Russians were guaranteed by a special law passed in July 1924.

The executive power is vested in the President of the republic, who is elected for seven years by both chambers in joint session. He is commander-in-chief of the army but may not assume active command in time of war; and nominates the cabinet ministers, who are responsible to parliament. The Polish President enjoys wide power. An amendment to the constitution in 1926 gave him authority to dissolve parliament upon the advice of the cabinet and to issue decrees with the force of law so long as parliament remains dissolved. Elections for a new parliament, however, must take place within 90 days from the dissolution. Among the President's official duties is the opening and closing of the *Sejm*. He is also authorized to make treaties with foreign nations on behalf of the republic. In the event of his death, his office is to be assumed by the speaker of the *Sejm*.

For purposes of local administration, Poland is divided into the City of Warsaw and 16 departments, *województwa*, which are divided into 277 counties, *powiaty*. There are 641 organized towns and 12,622 rural communities. The central government appoints the governors of the departments. The department of Silesia has its own autonomous, local government and a Diet elected by the people. A similar government for the department of southeastern Poland, where the Ukrainian population is concentrated, has been adopted in principal by the Diet.

Juridically the State is divided on a similar basis. The lowest courts are the County Courts, *sady grodzkie*, and the Courts of Peace, *sady pokoju*. Next in rank are the district courts and the courts of appeal. The highest court in Poland is the Supreme Court of Warsaw. Four different civil codes are now in force, the Napoleon code in former Congress

Poland, the Russian civil code in eastern Poland, the German civil code in the former German territory and the Austrian civil code in Galicia. Three penal codes exist, one for the territory of each of the former occupying empires. A commission of jurists has been at work for several years drafting a Polish civil and criminal code for submission to the Parliament. Certain sections of the Polish code have been completed, notably the law governing checks and bills of exchange, which is now uniform throughout Poland.

POLAND, HISTORY OF. After the migrations of the Slavonic tribes, those destined to form the Polish nation established themselves between the Baltic Sea, the Carpathian mountains, and the San, Bug and Elbe rivers. The first Polish ruler to play a part in history, Mieszko I, 960-92, married a Czech princess, Durbrovka, and was persuaded by her to adopt Roman Catholicism in 966. Thus, the Poles, instead of the Russians, who had adopted the Greek Orthodox faith, occupied the outpost of Roman Catholicism. There developed between the Poles and the Russians a conflict of cultures and religious faiths which exercised an important influence on the future of Poland. In the first period of its existence Poland increased rapidly in importance. Boleslas I, 992-1025, added to Poland the territories of Pomerania, Moravia, Slovakia and Silesia, and freed himself from his allegiance to the Holy Roman Emperor. After a period of troubles during which Boleslas I lost Slovakia, Moravia and Pomerania, under Boleslas II, 1058-79, and Boleslas III, 1102-39, the lost territories were recovered, and Poland was defended successfully against the Germans. At his death in 1139 Boleslas III had the kingdom divided into at least four parts. These were later divided into eight parts, and finally into many small states, each bitterly hostile towards the others. The chief among them was Little Poland, ruled by a duke, and containing the important city of Cracow.

In 1241, 1259 and 1281 the Tatars invaded Poland and in the course of their slaying and pillaging, reduced the middle class to such an extent that the Poles invited neighbors of the better classes to immigrate. These immigrants were mostly Germanic, and formed a middle class which developed the country under the overlordship of the nobles. With the powerful Teutonic Knights (*see* TEUTONIC ORDER) on the west and the Lithuanians on the east, Poland was finally saved by Wladyslas the Dwar, 1306-33, who united the petty states against their mutual enemies. He was succeeded by his son, Casimir the Great, 1333-70, Poland's first great ruler, who bargained with his neighbors, made marital alliances, and returned Poland to its former status as a European nation. Profiting by the troublous affairs in Russia, he acquired the rich province of Galicia and a part of Volhynia, in which he introduced Roman Catholicism. He gave Poland its first legal code, restricted usury, abolished corporate family responsibility for crime, and fostered education, founding the University of Cracow in 1364. At his death the throne passed to his nephew, Louis of Hungary, 1370-82. By the marriage of the daughter of

Louis, Jadviga, to Jagiello, Grand Duke of LITHUANIA, the territories of Poland and Lithuania were joined in a personal union in 1386. Thus the size of Poland was nearly doubled, the ancient Russian lands in Lithuania were transferred to Poland, and the Lithuanians were accepted into the Church. In 1410 a combined Polish and Lithuanian force dealt a crushing defeat to the Teutonic Knights at Tannenberg.

Jagiello, or Wladyslas II, was succeeded in 1434 by his son, Wladyslas III, who was in turn succeeded after a ten year period of stability of government by his brother, Casimir IV, 1447-92. During 1454-66 Casimir was generally successful against the Teutonic Knights, making Prussia a Polish province. In 1490 Casimir's son became king of Hungary, having been made king of Bohemia in 1471. At the turn of the 16th century Poland's trouble with Muscovy began, accompanied by attempts on the part of Prussia in the north and Moldavia in the south to separate from Poland, and by the incompetence of the reigning king, Alexander, 1501-06. But Sigismund, 1506-48, the fifth of the sons of Casimir IV, seeing the need for standing armies against the enemies on the frontiers, resisted the Muscovites for a time. Under Sigismund II, 1548-72, the last of the Jagiellons, the Grand Duchy of Lithuania was annexed to Poland in 1569.

Decay of Central Power. In the meanwhile important changes in the constitution of Poland indicated the gradual concession of royal power to the nobles. The kingship ceased to be hereditary and became elective, the voters being the nobility as a whole. Gradually the nobles gained control of the Diet, and imposed on each elected king certain conditions known as the *Pacta Conventa*. Sigismund II died without issue in 1572. During the reigns of the two Sigismunds the Renaissance began its work in Poland, evidenced by the flowering of literature and art at the city of Cracow. The Renaissance was closely followed by the Reformation, during which Poland was the field of battle of many of the warring sects of Europe. Except during the period 1555-65, Protestantism never gained a strong foothold in Poland, chiefly because of the petty disagreements between the Protestant sects.

In 1572-73 occurred an interregnum while the nobles tried to choose a king. They at length elected Henry of Valois, who reigned for 13 months, and then fled to occupy the throne of France. The next king, Stephen Bathory, 1575-86, a prince of Transylvania, was one of Poland's most successful rulers, Poland under his wise guidance reaching its peak in power. The first of his royal purposes, the submission of Danzig, he accomplished by defeating a coalition composed of the German emperor, Russia and Denmark. At home he conciliated the Cossacks, whom he used in war, by giving them partial autonomy in the Ukraine, and allowed the Polish Jews liberal privileges. He reformed the judicial system, and in 1579 established the University of Vilna.

The reign of the next king, Sigismund III, 1587-1632, afforded Poland a great opportunity for driving back the Russians on the east and for gaining major

control of the Baltic slavs on the north. But this opportunity, at a time when Germany was exhausted by the Thirty Years' War and the Muscovite tsardom was in a state of collapse, was wasted on account of the apathy of the Polish gentry and the bigotry of Sigismund. His ambition for the Swedish throne, his proposed union with Russia, and his inclination toward the Hapsburgs, involved Sigismund in wars with Sweden, Moscow, and Turkey; in none of the three was he successful. Under Wladyslas IV, 1632-48, Cossack support was lost to Poland, and under John Casimir, 1648-68, both Sweden and Russia, the latter aided by the Cossacks, invaded Poland. The Swedes were repulsed, but the Russians exacted a peace which began the long political influence of Russia in Poland. The next period of Polish history was to be marked by the incessant interference of European powers and the internal corruption of the *szlachta*, signalized by the reckless use of the *liberum veto*. Poland's last successful ruler was John Sobieski, 1674-96, who was victorious in his wars against the Turks and who delivered Vienna from the Turkish siege of 1683.

Decline and Partition. In the next century Poland rapidly declined. The struggle between Peter the Great of Russia and Charles XII of Sweden over the choice of a Polish ruler was disastrous for Poland, for when Peter the Great won out, he established both the king of his choice and the Russian influence which was to remain preponderant until 1918. Stanislas Poniatowski, 1764-95, agreeable to Catherine II, was the last king of Poland. During the 18th century the three famous partitions of Poland were made: the first, in 1772, gave White Russia, Lithuania and the Ukraine to Russia, Galicia to Austria, and Poznan (Posen) and Pomerania to Prussia; the second, in 1792, gave Volhynia and Podolia to Russia, and the cities of Danzig and Thorn with adjacent territory to Prussia; the third, in 1795, as a result of the uprising under Kosciuszko, gave the remainder of Lithuania to Russia, Warsaw to Prussia, and Lublin and Cracow to Austria, and caused the disappearance of Poland from the map of Europe. Napoleon reestablished the Duchy of Warsaw in 1807-15, a duchy composed of Prussian Poland and part of Austrian Poland. At the Congress of Berlin in 1815 a Kingdom of Poland corresponding more nearly to the Duchy of Warsaw was created and a constitution granted. Under the liberalism of Alexander I the Poles enjoyed rapid economic development. But after his death occurred the uprising of 1830 which led to the suppression of the constitution. In 1846 and 1848 there were insurrections against Austria and Prussia and in 1863 a second insurrection against Russia. The result in Russian Poland was the introduction of stern methods of Russianization, the suppression of the Union of Churches, the prohibition of the Polish language in Lithuania, and the closing of Polish schools. Bismarck issued a series of repressive measures in Prussian Poland. However, Austria established a moderate government granting certain rights to the Poles in 1867.

The Polish policy of Germany until the World War resulted in the formation of a self-reliant peasantry and middle class and the inculcation of discipline and of economic and cultural education; it also established a tolerant feeling between the landowners and the peasants by no means apparent in either Austrian or Russian Poland. Under Austrian government Galicia became practically an independent state, governed by the gentry for the benefit of agrarian interests; furthermore, with the grant of universal suffrage in 1896 and the decrease in illiteracy, Galicia enjoyed democratic politics, a new social order, and a new economic policy. By the outbreak of the World War Galicia had made a start on the path of material progress. Government in Russian Poland was carried on with one purpose—the Russianization of the province. To this end Poland was subjected to the repressive measures in force in the rest of the Russian Empire, and, although liberalism was felt for a brief period after 1905, the reaction of the tsarist ministers constantly held Poland strangled until the World War.

Reconstitution. The World War found Poland devastated by the contending armies and her people fighting, as a result of the partitions, in the armies of Germany, Austria, and Russia. Hence, there could be no national Polish policy. However, a Supreme National Council was formed in Galicia to cooperate with the Central Powers, and Pilsudski received authorization from Germany to form a Polish legion. In 1914 the Grand Duke Nicholas promised to create an autonomous Poland within the Russian Empire. In 1916 Germany and Austria-Hungary actually proclaimed the independence of Poland. The Russian Revolution in 1917 and the defeat of the Central Powers in 1918 made the situation favorable for the reestablishment of Poland. On Nov. 3, 1918, the newly-formed Polish cabinet issued a proclamation declaring Poland a republic. On Nov. 12 Pilsudski was appointed Commander-in-Chief of the Polish armies, and later he made himself head of the Government. Paderewski became the first premier in Jan., 1919. By the Treaty of Versailles Poland received the greater part of Posen and tracts in West Prussia, while plebiscites were to be binding in Masuria and Upper Silesia. Danzig was made a free city under the guardianship of the League of Nations, of which Poland was an original member, and was placed under the jurisdiction of Polish customs laws. Through the Danzig corridor Poland was granted free access to the sea. By her successive hostilities with Soviet Russia, Poland determined her new eastern frontier in 1921. In 1923 the Ambassador's Conference granted the city and district of Vilna to Poland instead of to Lithuania.

Since its national reestablishment, Poland has suffered from internal disorganization. In 1922, when Narutowicz, the first president, was elected, the Poles became infuriated because he had been elected through the national minorities, and a fanatic assassinated him. His successor was Wojciechowski. In 1923 the Polish currency fell in sympathy with the German mark. To save the situation, the *zloty*, a new unit, was in-

troduced. But it fell also, bringing chaos to internal affairs. In 1926 Marshal Pilsudski engineered his *coup d'état*, and set himself up as minister of war. Through his dictatorial policies he reformed the internal affairs and inspired confidence in his government in the minds of foreign nations. His policies were reaffirmed in the elections of 1927. By 1928 the judicial practices had been unified and a uniform code instituted, so that Poland was well on the way to nationalization under a strong central government. The year 1931 saw the further centralization of governmental powers through changes in the constitution and an attempt to balance the budget. A. L. R.

BIBLIOGRAPHY—*Historja polityczna Polski*, 2 vols., 1920-3, Roman Dyboski, *Outlines of Polish History and Poland Old and New*.

POLAR EXPLORATION. Every age has seen a change in the methods employed in polar exploration. After the failure of advance by water was realized, there came the period of probing the unknown from a land base in a high latitude from which sledge journeys could take their start. The baffling pack-ice proved that the modern ice-breaker has no place in serious polar exploration. In recent years the airplane and airship have appeared, and in one respect they can be used very successfully; that is, in aerial survey of difficult country that lies within reach of a base accessible by sea-transport and provided with a good landing-place.

Arctic Exploration. When it was realized that the discoveries of Columbus, Cabot and others of their time were not parts of Asia, but a new continent extending from far north to far south, it became necessary to find a way past this land. The Pacific was discovered and Cathay and the East were calling. Reports of fishermen who frequented the Newfoundland Banks no doubt discouraged any attempt to find this route by the north. MAGELLAN in 1520 succeeded in finding one by the south and this, no doubt, for a time diverted any endeavor that might otherwise have been directed to the north. But before the end of the century the possibility of a northwest passage was suggested; the search for a northwest passage had begun. In both cases the motive was solely commercial, in the hope of finding a route to the riches of the east. FROBISHER in 1576 begun the long quest for the passage. Later came JOHN DAVIS (1585, 1586 and 1587) who made a real advance and reached latitude 72° 12' N., in Davis Strait; Hudson in 1610 and BAFFIN in 1616 made some progress. For a long period after this the quest was not pursued, the conditions seeming wholly unfavorable to a trade route. French penetration to the south and west of Hudson Bay and Indian reports of copper in the north first led Samuel Hearne in 1771 to reach the mouth of the Coppermine river on the shores of the polar sea. In 1798, MACKENZIE descended the Mackenzie River to its mouth.

Arctic exploration now entered on a new phase. The sea channels free, or relatively free from ice, were known and had failed to yield the secrets of

high latitudes. It was no longer possible to hope for any progress by avoiding ice, but had become necessary to navigate the pack, pushing through the ice in the hope of finding a way out or at worst being able to retreat. The British government not only offered a large reward for the discovery of the passage, but provided men and ships for the quest. W. E. Parry in 1818 passed through Lancaster Sound and, making extensive discoveries, reached Banks (McClure) Strait in 114° W. long., where impenetrable ice forced him to return. With a little better luck, Parry would have reached Bering Strait. Journeys were made by Phepps, Scoresby, Buchan, J. Franklin and Parry to reach Bering Strait by northward way of the Greenland Sea, Parry attaining $82^{\circ} 45'$ lat., by leaving his ship and traveling with sledges. These journeys (1773 to 1827) were the beginning of the long endeavor to reach a high altitude and the pole itself, but they proved that line of advance to be impracticable. The fate of the Franklin expedition in 1845 (not a man returned), proved a powerful motive in stimulating polar exploration at a period when it might easily have lapsed. The many search expeditions made far more important discoveries than Franklin's own expedition. McClure entered the Arctic by Bering Strait and after two and a half years' extensive exploration was compelled to abandon his icebound ship on the north of Banks Island. He retreated with sledges over the ice of Barrow Strait and eventually reached Europe in one of a squadron of search vessels. McClure thus made the northwest passage, partly in ship, partly on foot. It remained, however, for AMUNDSEN to take a vessel from Atlantic to Pacific by the north. In 1903-'04 he took the *Gjoa* by Franklin's route and Dease Strait from Europe to Alaska.

There remained the northeast passage. When Weyprecht and Payer, in 1872, took their vessel to Novaya Zembya to explore the seas between there and Spitzbergen they had this quest in view. In this they failed, but their discovery of Franz Josef Land in 1873 was ample compensation. In 1878-79, NORDENSKJÖLD accomplished the northeast passage. He took the *Vega* from Europe to Japan via the Kara Sea and came home by the Suez Canal.

In 1879, the ill-fated Jeanette Expedition left San Francisco for the far north, in charge of Lt.-Commander G. W. DeLong. The ship was crushed in the ice, and although DeLong reached land, he died of starvation in Siberia. An international polar conference was held at Hamburg in 1879 and again in 1880. Delegates to the conference agreed that each nation should establish one or more polar stations, where synchronic observations could be taken for a year, beginning in August 1882. This plan was successfully executed. In 1881-83 Major General A. W. Greely established an international polar station at Lady Franklin Bay, $81^{\circ} 41'$ N. Greely ascertained the climatic conditions of Grinnell Land and the extension of Greenland to within fifteen miles of its extreme northern latitude. His geographic discoveries

north of the eightieth parallel extended one-eighth of the distance around the world.

In 1886, R. E. PEARY first turned his attention to arctic exploration with work in Greenland. From time to time during the next 23 years, he continued his explorations which became more ambitious with his growing experience. NANSEN's ship the *Fram* drifted from the New Siberian Islands to Spitzbergen in 35 months, the highest being $85^{\circ} 57'$ N. lat. in Oct. 1895. Nansen with one companion made a sledge journey to $86^{\circ} 14'$ N., the highest latitude reached until that time. Peary made northward journeys from Grant Land (Ellesmere Island) in 1902, from Greenland in 1906, and a final attempt from Cape Columbia reached the pole or its vicinity in 1909. This attainment turned arctic exploration into more strictly scientific channels.

In 1897, when navigation in the air was in its infancy, S. A. Andree made a disastrous attempt on the pole by balloon from Spitzbergen. With the developments in flying that are largely the outcome of the World War, airplanes have been employed to greater advantage than this early, unreliable means, but they do not permit the detailed scientific work which is the chief need in modern polar exploration. Amundsen, in 1925, made an unsuccessful attempt to fly to the pole and back. In 1926, R. E. Byrd made a flight from Spitzbergen to the pole and back, while Amundsen, Nobile and Ellsworth using a semi-rigid airship, *Norge*, succeeded in crossing the pole from Spitzbergen to Point Barrow and Telfer in Alaska. On April 15, 1928, G. H. WILKINS and Eielson, flew by airplane from Point Barrow to Spitzbergen, covering 2,200 miles in $20\frac{1}{2}$ hours. The dirigible *Italia* reached the pole on May 24, 1928. On its return to Spitzbergen the *Italia* was wrecked but Nobile, the commander, and most of his crew were saved after six weeks on the ice. Amundsen, who went in search of the *Italia* in an airplane, was lost.

Antarctic Exploration. Although JAMES COOK's attempts to find the southern continent were unsuccessful they laid the foundation of the exploration of the Antarctic. During his circumnavigation of the globe between 1772 and 1775, in high southern latitudes, Cook twice crossed the antarctic circle, being the first to do so, and made four unsuccessful attempts, in $39^{\circ} 35'$ E., 95° E., 145° W., $106^{\circ} 54'$ W. long. (and $71^{\circ} 10'$ S. lat.) to push southward. Ice baffled him each time. Cook believed that no one ever would push farther south than he had done, but if he did, "I shall not envy him the fame of his discovery, but I make bold to declare that the world will derive no benefit from it." On this voyage Cook found and named South Georgia, which had been seen by La Roche in 1675. In the second decade of the nineteenth century, American and British sloops were bringing sealskins from South Georgia and possibly other islands the existence of which, in fear of rivals, they kept secret. The first outcome of these voyages was the discovery of the South Shetlands by William Smith in 1819, the South Orkneys by

George Powell in 1821, the first sighting of the Antarctic continent in Feb. 1820, by Edward Bransfield, an Irish mariner in the British Navy.

Outstanding among the sealers was James Weddell of Leith. Leaving the South Orkneys in 1823 for the south in search of new sealing grounds, he passed all previous records in these seas. Weddell had to bear eastward on account of ice, but about the meridian of 30° W. he found a clear sea and headed south. Eventually he reached $74^{\circ} 15'$ S. lat., $34^{\circ} 16'$ W. long. before he put about. Weddell certainly chanced on an exceptional year, for no later explorer has found the Weddell Sea, or George IV Sea as he called it, so clear of pack ice. Dumont D'Urville, leading a French expedition in 1840, discovered Adelie Land. In the same year, the American expedition under CHARLES WILKES showed more enterprise and achieved greater success. Wilkes visited Adelie Land and traced the edge of the ice far to the west reporting several "high lands" in the direction of Enderby Land. Shortly after this Sir J. C. Ross, leading a well-equipped expedition, discovered South Victoria Land, the great volcanoes, Erebus and Terror, and the remarkable ice barrier at the head of Ross Sea.

Doubt as to the existence of a southern continent had now practically vanished. A day of great effort and more useful expeditions had arrived. In 1899 C. E. Borchgrevink in the British *Southern Cross* made the first wintering on the continent, at Cape Adare in South Victoria Land. Capt. ROBERT F. SCOTT, with the *Discovery* expedition 1901-04, investigated South Victoria Land and the Ross Ice Barrier, discovered King Edward VII Land, reached a world's record in $82^{\circ} 16'$ S., and established the extension of the South Victoria Land plateau well to the south. Dr. W. S. Bruce led the Scottish expedition in the *Scotia* in 1902 and discovered Coats Land, thus adding an enormous area to the dimensions of Antarctica. ERNEST H. SHACKLETON, who had accompanied Scott, made an attempt to reach the pole in 1908-09. He added considerably to the map and sledged over the high plateau to $88^{\circ} 23'$ S. lat. Using Shackleton's route, Scott reached the pole on Jan. 17, 1912, only to find that Roald Amundsen had reached there 34 days earlier, on Dec. 14, 1911. Amundsen chose a new route due south from the Great Ice Barrier and revealed a considerable new area of the edge of the Antarctic plateau. The fate of Scott and his four companions on their return journey marks the only disaster of such magnitude in the annals of antarctic exploration. Dr. DOUGLAS MAWSON, who had been on Shackleton's expedition, led an Australasian expedition to Wilkes Land in the *Aurora* (1911-14) which added a great deal to the coastline of the antarctic in King George V and Queen Mary Lands. Dr. W. Filchner in the *Deutschland* in 1912 extended Coast Land to the southeast by his discovery of the Luitpold coast. Three years later Shackleton added the Caird coast between the Bruce and the Luitpold coasts of Coats Land in his expedition in the *Endurance*.

Sir Hubert Wilkins, who had been in antarctic waters with Cope in 1920 and with Shackleton in 1921, reached Deception Island, his base, on a whaler in Nov. 1928. In a monoplane, with Lieutenant Eielson, he settled more problems and sketched more new coast lines in 10 hours than any other expedition had accomplished in west Antarctica.

On Dec. 25, 1928, COMMANDER RICHARD E. BYRD reached the Ross Ice Shelf with a large expedition prepared to stay two years. Byrd was supplied with several airplanes for which this site is particularly well suited. He surveyed much land, discovered new land and mountains, and made a flight to the pole.

Sir Douglas Mawson, in command of an expedition on the old *Discovery*, left Cape Town in Oct. 1929, to explore the shallow seas and coasts south of the Indian Ocean. A Norwegian expedition in the research-ship *Norvegia*, by a remarkable coincidence, sighted the *Discovery* in Jan. 1930 in the King Haakon VII Sea, between Coats Land and ENDERBY LAND.

POLARIS (*Alpha Ursae Minoris*), the Pole Star, also called North Star. Situated so close to the north pole of the heavens that to the naked eye it appears to stand still, in reality it, too, describes a small circle around the real pole. It is the brightest star of the constellation URSA MINOR and subject to minute light variations with a period of 4 days, is 200 light years distant, and sends out 450 times as much light as the sun. See STAR: map.

POLARITY, the state or condition in which two parts exhibit opposite characteristics, as do the two ends of a MAGNET; also, the state in which an axis exists with respect to which certain physical phenomena may be determined, as in polarized light (see POLARIZATION OF LIGHT).

When a DIELECTRIC is strained by a strong electrostatic field, as, e.g., the dielectric of a highly charged CONDENSER, the ELECTRON orbits in the individual ATOMS of the medium are distorted, so that the atomic nuclei are somewhat displaced in the direction of the field and the electrons in the opposite direction. When in this condition, the dielectric exhibits polarity. The effect is called electric polarization.

If the atom is regarded as a simple Doublet consisting of equal positive and negative charges at a fixed distance from each other, polarization may be considered as an orderly arrangement of these doublets in which the positive poles are turned one way and the negative poles in the opposite direction. If the atom consists of a positive nucleus with electrons revolving around it in circular orbits, polarization probably means a distortion of the electron orbit into a form, an ellipse, such that the electron is on one side of the nucleus longer than on the other. If the electron orbit is normally elliptical, polarization must mean that the electron orbits are turned with their major axes parallel to the field. See also ELECTROLYSIS.

L. B. S.

POLARIZATION OF LIGHT, a condition of radiant energy, very noticeable in light, during which

some of its properties, especially capacity for transmission and reflection, are different in different directions. The accepted explanation lies in the WAVE THEORY of light, according to which light is due to periodic vibrations in a medium, the vibrations being at right angles to the direction of propagation, thus generating a transverse wave. In ordinary light the plane of this transverse vibration is changing irregularly many thousands of times per second. If the plane were constant, the light would be plane-polarized.

Some doubly refracting crystals (*see* DOUBLE REFRACTION) have the property of absorbing all vibrations in one plane and transmitting those in a plane at right angles thereto, which process furnishes plane-polarized light. When light is reflected from various substances at certain angles, the vibrations in one plane are reflected better than those at right angles, and the reflected light is partially plane-polarized, i.e. there is more energy of vibration in the one plane than in the plane at right angles thereto. When ordinary light passes through a calcite crystal, the light is resolved into two components, each being plane-polarized. By suitable cutting, as in the NICOLS PRISM, one component is eliminated, and the transmitted light is plane-polarized.

A device, such as the Nicols prism, which polarizes light is called a polarizer. An analyzer must be used to learn whether the light and its plane are partially or completely polarized. Any polarizer may be used as an analyzer by being rotated about an axis along the direction of the light beam. It will be found that in certain positions of the analyzer the light will have maximum intensity, and at right angles thereto it will have minimum intensity. The plane of polarization of light is altered or rotated by the passage of polarized light through quartz, through other crystals and through some solutions. (*See* OPTICAL ROTATION.)

According to the ELECTROMAGNETIC THEORY, light consists of an electric and a magnetic component of vibration. The magnetic component is in the plane of polarization, the electric component at right angles to it.

P. I. W.
BIBLIOGRAPHY—Wood, *Physical Optics*.

POLAR ZONES, the areas at the extremities of the globe, also known as the polar regions, the northern one being bounded by the arctic circle and the southern by the antarctic circle. Their combined area is about one-twelfth of the earth's surface. The distribution of land and water in the northern zone is the reverse of that in the south. All the continents of the northern hemisphere extend north of the arctic circle. In North America, Alaska and Canada project into this zone; in Europe, Norway, Sweden, Finland, Russia and Siberia. In addition there are Greenland, Spitzbergen, Franz Josef Land and other islands. In the southern hemisphere, none of the continents of the temperate zone reaches the antarctic circle and the only land within it is ANTARCTICA, a mountainous polar plateau mostly covered with snow and ice. Both regions are alike in having the sun above the horizon

for more than 24 consecutive hours, and below for a similar period, once each year. At their outer boundaries, the longest period of continuous sun is but a few days, which time increases poleward until at the poles it is six months. Since the rays are so oblique they have little effect in warming the atmosphere, although they do melt the snow and ice to some degree.

Both regions are practically covered by a perpetual pack of ice which is caused by the climate and in turn affects the climate. This ice is not due to heavy snows but to the preservation of that which falls, since the precipitation is light, owing to low temperatures and slight evaporation. The climate of both regions is classed as glacial and the differences are mainly that the winters on the antarctic coast are not so cold as similar latitudes in the arctic regions; the summers, however, are the coldest on earth. The following temperatures are characteristic.

In the arctic: North Greenland at 82° N. lat. 64° W. long., mean for Jan. —36.2° C. and for the year —19.3° C.; West Spitzbergen at 78° N. lat. 16° E. long., mean for Dec. —16.3° C., for July, 4.3° C. and for the year —8.2° C.; Point Barrow at 71° 20' N. lat. 156° 20' E. long., mean for Jan. —28.3° C., for July 3.6° C. and for the year —14° C.

In the antarctic: Cape Adare at 71° 18' S. lat. 170° E. long., mean for Aug. —25.3° C., for Jan. 0.7° C. and for the year —13.6° C.; South Victoria Land at 77° 45' S. lat. for the year —17.4° C.; Framheim at 78° 38' S. lat. 163° 37' W. long., mean for Aug. —36.8° C., for Dec. —4.6° C. and for the year —24.1° C.

The ARCTIC ZONE is a true polar desert in the center but toward its outer edges, where its coasts are free of ice, there are growths of stunted trees, mosses, lichens and grass tundras. In these regions live reindeer, musk ox, polar hares and foxes and in the waters are polar bears, whales, seals and walrus. Eskimos are the principal human inhabitants.

In Antarctica there is no human population and there are no land animals except very minute ones. Scattered mosses and lichens are found at rare intervals on the coast where the land protrudes through the ice. In the water, however, there are extensive flora and fauna. Penguins, whales and seals exist in great numbers. *See also* POLAR EXPLORATION.

POLECAT, a large weasel (*Mustela putorius*) of the Old World. It is about 2 ft. long, including the tail, and its loose brown fur is known as "fitch" (although the Siberian species, *Mustela eversmanni*, produces most of the "fitch" fur), and the weasel itself as a "fitchet." No animal is more dreaded by gamekeepers and poultrymen than this pest, happily for them now scarce in western Europe. When disturbed, it emits a vile odor, giving it the name "fou-mart" (foul marten). American skunks are often called polecats, but they are very different animals. An albino variety of polecat has been domesticated and serves as a ferret in some parts of southern Europe.

POLES, in geography, are the two points of intersection of the surface of the earth and its axis of rotation. This axis, when indefinitely extended, intersects the celestial sphere in two points named the **CELESTIAL POLES**.

POLES, CELESTIAL, the points on the celestial sphere where it is intersected by the indefinitely extended axis of the earth.

POLE VAULTING, a term for hurdling a bar with the aid of a long pole. Now common to all track meets, pole vaulting at first was the practice of springing over ditches and small streams by means of a strong staff. The present-day art is governed by rules pertaining to the uprights, bar and the pole. Proficiency requires long training, speed, balance and considerable strength in the arms and shoulders. Under the rules of the American Amateur Athletic Association, the uprights must not be less than 12 feet apart. The pole is of bamboo, having a blunt end which the vaulter slips into a slideway, placed 1 foot in front of a line between the uprights. On the other side, the pole vaulter lands in a sand pit.

Pole vaulters to-day employ two methods: swinging the legs to the side and upward in one action; swinging the legs straight up before the pole is vertical, and turning the body face downward, so that the bar lies just under the abdomen. Sabin W. Carr of Yale in 1927 made a record of 14 ft. On Apr. 28, 1928 Lee Barnes of the University of Southern California broke this record, clearing 14 ft., $\frac{1}{2}$ in.

POLICE POWER. In American constitutional law the power of the legislature to interfere with liberty and property in order to maintain the public health, safety or morals; the power to make laws for the preservation of public order, protection of public health, safety and morals, and the definition, detection and punishment of crimes. Recently there has been a tendency to give this conception wider content so as to embrace, in addition to the general security and general morals, the conservation of social resources and general progress.

POLICY, INSURANCE, a contract in writing which stipulates that one party will pay to another a specified sum of money upon the occurrence of a certain event against which the latter party is said to be insured (*see* **INSURANCE**). The contract also states that the insured party shall make certain payments in consideration of the protection.

POLIOMYELITIS. *See* **INFANTILE PARALYSIS**.

POLISH CORRIDOR, an area, consisting of Posen and most of West Prussia, along the Vistula River, taken from Germany by the **TREATY OF VERSAILLES**, 1919, and given to Poland, without a plebiscite, in order to give this land-locked country a Baltic seaboard. It was the largest slice of territory taken from Germany by this treaty. This settlement, which separated the mass of industrial Germany from agricultural East Prussia, has been a constant source of trouble between Germany and Poland. A situation was created on which Germany bases some of her strongest arguments for a revision of the Treaty of

Versailles. Especially so, because Poland herself has violated the terms of the treaty by drawing the eastern frontier of the Corridor so as to deprive East Prussia of the right to use the Vistula. The German Government has signified its unwillingness to accept permanently this settlement of its frontier.

German opposition has been based chiefly on the economic and cultural effects of the settlement. The Corridor cuts across the old established trade routes of East Prussia with Germany and more particularly with old West Prussia. The bulk of East Prussian trade was with the territory now occupied by Poland. The Polish Government has practically eliminated this trade by high tariffs, bringing ruin to German East Prussia. Moreover, Polish activity during the past 11 years in building a great port at Gdynia seriously threatens the economic existence of Dantzig. The Germans regard the German culture of Dantzig and East Prussia as doomed. On the other hand, the Poles attempt to justify the settlement on the basis of historical and racial arguments. This region has always been a part of Poland in the past, and was inhabited by Poles. The Polish Government has been trying to increase this racial balance in its favor by a policy of de-Germanization in the area. To this end many measures discriminating against the German population have been adopted. A. P. W.

POLISHING MACHINES, machines for finishing metals by rubbing or grinding off the thin outer skin, as on castings, leaving them smooth for further **BUFFING**. Polishing machines are made in many forms but much of this work is still done by hand.

POLISH LANGUAGE, the most important member of the West SLAVIC group of languages.

The Polish language is now spoken by about 18,000,000 persons in Poland, 850,000 in Germany, 790,000 in Russia, 80,000 in Czecho-Slovakia, 100,000 in Lithuania and Latvia, and 1,100,000 in the United States. It is less archaic than Czech (*see* **CZECHO-SLOVAK**), is characterized by nasalization of *a* and *e*, and has its accent fixed always on the penultimate syllable. The vocabulary is full of foreign words, chiefly from German and Latin. The language is divided into many dialects, which may be classified as 1. Great Polish, with Posen as the center; 2. Mazurian, with Warsaw as the center; 3. Little Polish in Galicia, with Cracow as the center; 4. Lithuanian Polish, with Vilna as the center; and 5. Prussian and Silesian Polish, strongly interspersed with German elements. The Mazurians of East Prussia, though speaking a very distinct dialect, are real Poles linguistically. Literary Polish is based chiefly on the dialect of Posen. The earliest documents date from the 14th century, and Polish was long the principal medium of intellectual culture for large parts of Lithuanian, White Russian and Ukrainian territory.

A. SE.

BIBLIOGRAPHY.—A. Soerensen, *Polnische Grammatik*, 2 vols., 1899-1900; J. F. J. Baluta, *Practical Handbook of the Polish Language*, 1915; A. Meillet and H. de Willman-Grabowska, *Grammaire de la langue polonaise*, 1921.

POLISH LITERATURE. From 966, when Poland became Christian, until the 16th century, the literary language of the country was Latin. The chronicles are important and the *History of Poland* by Dugosz (1415-80) shows the dawn of historical research. In Polish a hymn to the Virgin dates from the 13th century; homilies and religious verse remain from the 14th; in the 15th secular poetry began.

In general, Poland has no important medieval literature in its own language. But by the 16th century Poland had become a powerful and prosperous nation; and, under the influence of the Reformation and the Renaissance, speedily developed a vernacular literature of real beauty and power. Rej (1505-69), the first important author, was a vigorous opponent of the Catholic Church. His *Mirror*, in prose, describes vividly the life of the Polish gentry; his homespun verse, didactic and satiric, lacks artistic merit. Kochanowski (1530-84), trained in Italy, wrote both Latin and Polish; until the 19th century he remained the greatest Polish poet. His work is mainly lyric, his masterpiece is a series of *Laments* for his little daughter Ursula. The chief prose author of this early Golden Age is the Jesuit Skarga (1536-1612), a stout champion of the royal authority and of the Catholic Church; his *Sermons before the Diet* show his religious fervor and classical training. Of other prose writers and poets, both in Latin and in Polish, there were many. Their work continued into the 17th century, but with the triumph of the Catholic reaction, the cessation of religious controversy, and the decline of public spirit, Polish literature degenerated; in the early 18th century it hardly existed. The *Memoirs* of Pasek (c. 1630-1701) portray life among the turbulent nobles of the decadent period.

A rebirth of national patriotism is shown in the writings of the publicists Konarski (1700-73), reformer of Polish education; Staszyc (1755-1826), champion of the oppressed peasantry, and Kollataj (1750-1812), chief proponent of political reforms. Under the patronage of Poniatowski, the last king of Poland, belles lettres revived, naturally in a form dominated by the French taste then prevailing in Europe. Of this school the leader is I. Krasicki (1735-1801), famous as a poet for his fables and satires, as a prose writer for his moralistic tales. Other poets voice the sentimental tendencies of the period. The French school survived the partitions of 1772, 1793, 1795; Fredro (1793-1876), a disciple of Molière, is the greatest Polish writer of comedy.

The Romantic movement (*see* ROMANTICISM) gave rise to the finest poetic literature of Poland; the years of deepest national humiliation were those of poetic triumph. Mickiewicz (1798-1855), Slowacki (1809-49) and Krasinski (1812-59) are the Polish national bards. They wrote for the most part in exile, either forced or voluntary; after the futile insurrection against Russia in 1830-31, Paris became for some 20 years the literary capital of Poland. Their themes are predominantly patriotic, with a strong mystic and prophetic tinge. Mickiewicz in his *Forefathers' Eve, Part*

III, and his *Books of the Polish Nation* created the doctrine of Polish Messianism: Poland is the Christ among nations, she has been crucified, a sinless victim, and with her approaching resurrection a new historical epoch will begin. On the other hand, his *Pan Tadeusz*, the national epic of Poland and the only successful epic of the 19th century, is objective; it is a tale of life in Lithuania in 1811-12, full of sweetness and humor mingled with dignity and noble patriotism. Slowacki, the greatest technical master of Polish verse and a copious dramatic and epic poet, also strove to give a spiritual interpretation to Polish history. Krasinski, in the poetic prose of his *Undivine Comedy* and *Iridion* and the glowing verse of his *Dawn*, preached a doctrine of non-resistance whereby Poland should gain salvation and become the world's religious inspiration. The dramatist Wyspianski (1869-1907), the greatest poet of the following era, continued the Romantic spirit; in his *Wedding* he contrasts Poland's modern despondency and irresolution with her past glory.

In Poland as elsewhere, the years since 1850 have been most notable for prose fiction. The chief names are Mme. Orzeszko (1842-1910), Glowacki (1847-1925), SIENKIEWICZ (1846-1916), Przybyszewski (1868-1927), ŻEROMSKI (1864-1925) and STANISŁAW REYMONT (1868-1925). Orzeszko and Glowacki are realists, dealing in fiction with the problems of Polish society. Sienkiewicz, the greatest historical novelist of his time in Europe, gained world-wide fame by *Quo Vadis*, a story of Rome under Nero, but his trilogy of warring seventeenth-century Poland, *With Fire and Sword*, *The Deluge*, *Pan Michael*, is even finer work. Here and in his realistic novels, *Children of the Soil* and *Without Dogma*, he expresses the traditional ideals of the Polish gentry, of religious faith and patriotism. The stylist Żeromski, a pessimist in his varied work, both historical and realistic (*Ashes*, *The Faithful River* and other novels), voices the national spirit in a more subtle and complex fashion. Przybyszewski represents the sex school in Polish literature. Reymont, a man of humble birth, gives in *The Peasants* the most comprehensive and sympathetic study of peasant life ever written. Both Sienkiewicz and Reymont won the Nobel Prize for Literature.

G. R. N.

BIBLIOGRAPHY.—R. Dybowski, *Periods of Polish Literary History*, 1923; R. Dybowski, *Modern Polish Literature*, 1924, J. Krzyżanowski, *Polish Romantic Literature*, 1930

POLISH NATIONAL CATHOLIC CHURCH OF AMERICA, a religious body which organized as a result of the increase of immigration from Poland and differences of opinion between Polish Roman Catholic churches and the heads of the Roman Catholic Church in the United States. In Chicago, Buffalo, Cleveland, Scranton and other places in Pennsylvania Polish Roman Catholic congregations rebelled against non-Polish priests who had in some instances been placed in charge of the Polish parishes. Much of the early work of establishing the National Church was due to the efforts of Father Francis

Hodur of Nanticoke, Pa., whose weekly paper, called the *Straz*, was widely circulated. In 1904 a convention of those interested in the movement met at Scranton, when 147 delegates gathered, representing 20,000 adherents in the five states of Pennsylvania, Massachusetts, Connecticut, New Jersey and Maryland. Father Hodur was elected bishop and was subsequently consecrated as such by Archbishop Gul of Utrecht in Holland, with the assistance of other bishops. In doctrine the Church accepts the decisions of the first four ecumenical councils of the early church, as interpreted by the Synod. It rejects the doctrine of the infallibility of the Pope and holds that all men have the right to interpret the Bible according to their convictions and conscience. In polity the Church is governed by a synod, which meets every five years. In 1931 the Polish National Catholic Church of America had organizations in nearly a dozen states and possessed a membership of approximately 40,000 worshippers.

POLITICAL ECONOMY, the study of production, distribution and exchange of social wealth. Originally, political economy was the regulation of government policies and politics for the increase of national wealth. *See also* ECONOMICS.

POLITICAL SCIENCE, the science primarily concerned with the phenomena of the STATE in all its manifold aspects and relationships. The fundamental problems of political science according to Professor Garner encompass first, an inquiry into the nature of the state and "the formulation of fundamental principles of state life"; second, an analysis of the "nature, history, and forms of political institutions"; and third, "a deduction therefrom" insofar as it is possible "of the laws of political growth and development." Any such analysis inevitably leads into a consideration of the essentials of a state; the forms of states and of governments; constitutions and principles of constitutional organization; the sphere and functions of states; the problem of SOVEREIGNTY, besides many others.

The objection is frequently raised that political science is by definition a misnomer. Emphasis is laid upon the impossibility of applying to the collection and analyzing of data in the field of the social sciences, the same rigorous scientific methods of investigation used in the physical sciences. Difficulties must be conceded. Particularly is the political scientist handicapped by the almost insurmountable difficulties surrounding any attempt at what the physical scientists call a "controlled experiment." The controversy is one of definition, however. In his *Grammar of Science*, Karl Pearson states, "The classification of facts and the formation of absolute judgments upon the basis of this classification essentially sum up the aim and method of modern science"; and again, "the classification of facts, the recognition of their sequence and relative sequence, is the function of science." If this is a recognized definition of science, and authorities seem to agree that it is, then the study of the state can certainly claim the rank of a science.

Inevitably, the methods of political science will differ from those of the physical science just as the methods of the several physical sciences differ among themselves. Six methods in general have been used in the study of political institutions. First, the observational or reportorial. On the basis of the data thus recorded an effort is made to make such deductions relative to the nature of the state and the processes of government as may seem justified and reasonable. Second, and somewhat more complicated, is the comparative method. It attempts through an analysis of existing political institutions to assemble a body of material from which the student of politics may, by selection, comparison and elimination, obtain information on the basis of which he may evaluate principles of political organizations and processes of political action with some degree of certainty. A third method of study in the field of political science is the historical. It is in reality merely an aspect of the comparative method. The historical method, says Professor Garner, "brings in review the great political movements of the past, traces the organic developments of the national life, inquires into the growth of political ideas from their inception to their realization in objective institutions, discovers the moral idea as revealed in history and thereby points the way of progress." Aristotle, Montesquieu, De Tocqueville and Bryce are, perhaps, the leading exponents of this method. More recently a fourth method, designed to safeguard the handling of mass data, has been evolved, viz., the statistical method. This mathematical technique is not confined in its application to political science. Indeed its greatest development thus far has been in the field of sociology and political economy. Two other methods deserve mention, the psychological and the experimental. Thus far, neither of them in their application to political science, has developed beyond an exceedingly experimental stage.

It is not by the application of any one of these methods to the study of the state that the science of politics is to advance but rather through the judicious use of all. "In the present state of knowledge," said Buckle writing in his *History of Civilization* in 1857, "politics so far from being a science is one of the most backward of all the arts." S. C. W.

BIBLIOGRAPHY.—J. W. Garner, *Introduction to Political Science*, 1910; Karl Pearson, *Grammar of Science*.

POLITICS, this term may be used to include the entire science of government; as such it is synonymous with **POLITICAL SCIENCE**, or it may be confined to the processes by which the government is managed and the ends of the state achieved. Frequently it is still more narrowly defined, referring only to the art of party management. It is also used to designate the policy-deciding function of government as distinguished from the administrative.

POLIZIANO, ANGELO AMBROGINI (1454-94), Italian poet and scholar, known also as Politian, was born at Montepulciano, Tuscany, July 14, 1454. Under the patronage of Lorenzo de' Medici he secured a post in the University of Florence. Here his great

learning attracted many students who afterwards became famous in literature. Politian's writings include juristic texts on the codes of Justinian, a series of essays on criticism and several masterpieces in Latin verse. In addition to his Latin works, Politian responded to Lorenzo de' Medici's dream of establishing the Italian language in literature by producing *Orfeo*, a lyrical drama that is the first good example of its type in Italian literature. Poliziano is accounted one of the most brilliant scholars of the Italian Renaissance. He died obscurely, probably in Florence, Sept. 24, 1494.

POLK, JAMES KNOX (1795-1849), eleventh President of the United States, was born in Mecklenburg Co., N.C., on Nov. 2, 1795. His parents, Samuel and Jane Knox Polk, were of Scotch-Irish descent, and engaged in farming near the North Carolina frontier. When Polk was 11 years old, his parents crossed the mountains to settle in Maury Co., Tenn. He returned to his native state to enter the University of North Carolina, where he was graduated in 1818. Polk devoted the next two years to studying law in the offices of Felix Grundy at Nashville, Tenn., and began practice in 1820 at Columbia, seat of Maury Co. Four years later he married Sarah Childress.

Polk soon undertook public office. At the age of 28 he was elected to the Tennessee legislature, where he remained two years, after which he served in the national House of Representatives until 1839. In these active years he established himself as a Democratic leader. He consistently opposed Clay, supported Jackson, and was speaker in 1835-39, an office then particularly difficult because of the prevailing bitterness between Congressional factions. As early as 1839 Polk was considered Presidential calibre by the Democrats. At this critical period in American political history Polk wisely left Washington, and became governor of Tennessee. The state was of increasing economic and political importance in national affairs, and Polk added to his prestige as its governor until 1841, although he was defeated by the Whig candidate in that year and again in 1843. These defeats did not impair his national reputation, and he continued to be held in high regard by his party. In 1844 he was suddenly nominated for the Presidency as a "dark horse" candidate brought forward when MARTIN VAN BUREN unexpectedly announced his opposition to the Texas annexation. Upon this announcement, southern delegates to the Democratic National Convention at Baltimore obtained releases from their instructions. After voting down Van Buren, the Convention agreed on Polk. He had the support of Calhoun, leader of the South, and he was known to be strongly in favor of bringing Texas into the Union, which was the chief plank in the Democratic platform. With George M. Dallas as the vice-presidential candidate, Polk received 170 votes against Clay's 105, and took office in 1845.

Polk stood firmly for the Democratic platform. His cabinet members, among them James Buchanan, Secretary of State, Robert J. Walker, Secretary of the

Treasury, William L. Marcy, Secretary of War, and George Bancroft, Secretary of the Navy, were appointed in alignment with the expansionist policy; i.e., the annexation of Texas, California, and the reoccupation of Oregon, part of which was claimed by Great Britain. Soon after taking office Polk encountered strong opposition to his projects from the Whig members of Congress, but in his four years as chief executive he succeeded in all his major aims. Polk was in greater or lesser degree responsible for the four outstanding achievements of his administration: (1) the establishment of an independent federal banking system, (2) tariff reduction by the Walker measure of 1846; (3) settlement of the Oregon boundary by treaty with Great Britain (*see OREGON BOUNDARY TREATY*); (4) the acquisition, consequent to the MEXICAN WAR, of 1,000,000 square miles of valuable territory in Texas, New Mexico, Arizona and California. In 1848 his administration received the nation's applause for the admission of Wisconsin as a state. Other measures for which Polk was in part responsible were the creation of the Department of the Interior and the establishment of the Naval Academy at Annapolis. Despite these achievements the President began to lose support in the second half of his term. By the Oregon treaty he had lost to Great Britain a considerable area of disputed territory, including Vancouver Island, and his veto of a bill providing for harbor improvements on the Great Lakes lost him the support of the Northwest and Middle West. The resulting political reaction split the Democratic party, making his renomination impossible. In the following election, Polk's candidate, LEWIS CASS, was soundly defeated by the Whig party. Polk retired to his home at Nashville, Tenn., where he died three months after completing his term, on June 15, 1849. He was buried at Nashville.

Polk has been criticized posthumously as the "greatest American imperialist"; unquestionably, he prosecuted the Mexican War vigorously, and did not restrain the cry of the land-hungry.

BIBLIOGRAPHY—*Diary of James K. Polk . . . 1845 to 1849* (1910), edit. by M. M. Quaife, E. I. McCormac, *James K. Polk*, 1922; George Bancroft, "James K. Polk" in *Wilson's Presidents of the United States*, 1894.

POLKA, a Bohemian dance in brisk tempo and duple meter, said to have originated in 1830. Its characteristic rhythm is the following:



POLLACK, the common name for certain marine fishes of the Cod family (*Gadidae*). The common pollack (*Pollachius virens*), called also coalfish and green cod, abundant on both sides of the North Atlantic, is greenish brown above and silvery below. Usually it is about 2 ft. long and weighs from 4 to 12 lbs. The pollack is an active fish, moving in large shoals, and is found at all depths, feeding rapaciously upon fishes and small crustaceans. Though inferior to the cod, the pollack is extensively used as a food

fish both fresh and salted. In 1929 the total catch in United States waters, practically all off New England, was 14,356,000 lbs. valued at \$372,000. The Alaska pollack (*Theragra chalcogramma*), dark olive in color and sometimes 3 ft. long, extensively eaten by the Aleuts, forms a large part of the food of the fur seal.

POLLARD, ALBERT FREDERICK (1869-), English historian, was born at Ryde, Isle of Wight, Dec. 16, 1869, and educated at Oxford. He held the post of assistant editor of the *Dictionary of National Biography*, 1893-1901; from 1903 to 1927 he was professor of English history at the University of London; and in 1927 he became director of the Institute of Historical Research. His many historical works include several studies of the Tudor period, a life of *Henry VIII*, 1906, and *Factors in American History*, 1925, and *Evolution of Parliament*, 1926.

POLLARD, EDWARD ALBERT (1828-72), American journalist, was born in Nelson Co., Va., Feb. 27, 1828, and graduated in 1849 at the University of Virginia. As editor of the *Richmond Examiner* in 1861-65, he supported the Confederacy, but severely criticized President Jefferson Davis. Although a talented writer, he was often prejudiced to the point of being unfair in his criticisms. Among Pollard's works are *Black Diamonds*, *Southern History of the War* and a *Life of Jefferson Davis*. He died at Lynchburg, Va., Dec. 12, 1872.

POLLEN ASTHMA. See also HAY FEVER.

POLLINATION, a term used to designate the transfer of pollen from the stamens to the pistils of flowering plants, called also pollenization. In the older botanical literature, the word "fertilization" also referred to or included this process in the scope of its meaning, and thus it is frequently stated that "insects effect fertilization" merely by carrying pollen to the pistils of flowers. It is now more correct to use the term pollination only for the transfer of pollen, and the term fertilization only for the processes which occur in the pistil leading to and including the fusion of the egg and the male cell.

As to the means operating in the transfer of pollen there is pollination by insects and other animals, especially by certain birds and snails, and by movements of air and water. Many intricate adaptations are involved in the structure and the physiology of flowers and in the habits and structure of insects. As to the particular source of the pollen and the process involved there may be: (1) self-pollination or autogamy, which involves stamens and pistils of the same flower; (2) close-pollination or geitonogamy which involves the stamens of one flower and the pistils of another flower, all on the same plant; (3) cross-pollination or xenogamy, which involves organs of different individuals of the same species but not of the same clone; and (4) hybridization pollination involving pollination between species, which is frequently called cross-pollination. The propagation of plants as clones makes it necessary to recognize intracloonal pollination as essentially the same as close-pollination.

Various classifications have been suggested for the modes of pollination, the types of adaptations, and the distribution of sexes in flowers and in plants, since these influence and regulate pollination.

The matter of proper and adequate pollination assumes great practical importance in the culture of horticultural crops, especially those grown for fruits as apples, pears, plums, pecans and avocados in which cross-pollination is often necessary for the production of fruit. In all flowering plants, except those that produce seeds by apogamy, pollination is a necessary stage in seed reproduction. A. B. S.

BIBLIOGRAPHY.—Paul Knuth, *Handbook of Flower Pollination*, trans by J. R. Ainsworth Davis, 1906.

POLL-TAX, sometimes called a capitation or perhaps capitat, is an equal contribution to the public funds by all individuals of a certain age. There is little justice and insignificant revenue in the use of the poll-tax, though most states in the United States use it in one form or another. In some instances it takes the form of a registration fee in the exercise of the SUFFRAGE.

POLLUX, JULIUS, Greek rhetorician, was born at Naucratis, Egypt, toward the close of the 2nd century. He taught at Athens, where he was protected by the Emperor Commodus. His principal work was a Greek dictionary dedicated to the emperor. Though clumsily arranged, this work gives much valuable information about ancient life.

POLLUX, in Greek mythology, the twin brother of Castor, together known as the Gemini and the Dioscuri, sons of LEDA. See CASTOR AND POLLUX.

POLLUX (*Beta Geminorum*), a star of the first magnitude and the yellow, brighter, and more southerly of the Twins. (See CASTOR.) It is 32 light years distant, and 28 times brighter than the sun. See STAR: map.

POLO, MARCO (c. 1254-1324), famous medieval traveler, born in Venice about 1254. A commercial enterprise took his father, Nicolo, and his uncle, Maffeo, to Bokara in 1260, where visiting envoys of Kublai Khan persuaded them to make the journey to China. They were cordially received by the great Khan, who had never before seen Europeans. From purely political motives, the Khan became interested in Christianity, and the Polos returned to Europe bearing his request to the Pope for 100 men to undertake the education and Christianization of China. In 1271, the Polos started back to China taking with them but two Dominican monks, who soon lost their courage and turned back, and Nicolo's 15 year old son, Marco. On their arrival in China in 1275, they were again kindly received, and Marco rose high in government service and in the Khan's favor. The Polos left China by sea in 1292, having been sumptuously outfitted by the Khan, and, after many adventures reached Venice in 1295. In a battle between the Venetians and Genoans in 1298, Marco was taken prisoner, and during his year's confinement in Genoa dictated in French the story of his experiences to a fellow-prisoner, Rusticano of Pisa. The Polos were the

first European travelers in China; the first to traverse the wide and treacherous continent of Asia; and the first to tell the European world of the amazing civilization of China, and of Tibet, Siberia, Japan, Burma, Siam, Java, Ceylon, Zanzibar and Madagascar. Marco Polo died in Venice sometime during 1324.

POLO is the most ancient game played with stick and ball known to mankind. Since most games are played with these implements, or their counterparts, polo is very nearly the oldest sport known to the human race. Traces of the game indicate that it was played before the Christian Era, the earliest indications which are universally accepted being Persian and dating 600 B.C., with no proof that this marked the beginning of the sport. From Persia the sport has been traced through Constantinople, Turkestan, Tibet, China and Japan. It came to the western world through India. The game was apparently very popular in India in the 16th century. It has had several forms, at times during its record being played with racquets and leather balls; but it has always had the same basic elements of horse, man and goal scoring. Its modern form is quite recent, dating in reality from the closing years of the past century.

The West first learned of the game through officers of the British Army in India who brought it back with them. The first game played in the western world was in 1871 on Hounslow Heath, England, between teams of the 10th Hussars and the 9th Lancers, British Army. The 10th Hussars had been experimenting with the game since 1869 and had challenged the 9th Lancers. Eight men played on a side in this game, using hockey sticks and small ponies, not much over 12 hands high, imported from Ireland for the game. The field was a bit short of 200 yards in length; the goal posts were 20 feet apart. There were few rules. The sides each lined up at their own goal, a sergeant-major threw the white, wooden ball in the middle of the ground and both sides raced for it. That game lasted an hour and a half.

Rules To-day. To-day the game is played by four men a side using horses of any height. A regulation turf field shall not exceed 300 yards in length and 160 yards in width, the sides marked by boards not exceeding 11 inches in height. Goal posts are 8 yards apart. The ball shall not exceed $3\frac{1}{4}$ inches in diameter nor weigh more than $5\frac{1}{2}$ ounces. Official games consist of eight periods of $7\frac{1}{2}$ minutes each, with intervals of three minutes after each for changing ponies and an interval of five minutes at half time. In each period, play continues after the timekeeper's bell rings until the ball goes out of bounds, strikes a sideboard, a goal is scored or a foul made. Extra time thus consumed is deducted from the following period. Play starts in the following period at the point where it ceased at the close of the last. Games are under the jurisdiction of an umpire, who throws the ball in to start and who calls fouls. International and important championship matches may have two umpires on the field and a referee in the stands to decide points of issue between umpires.

Rules of play are designed mainly to hold down the danger of accidents. They prevent crossing a player who is following the line the ball has last taken close enough to create danger of collision; prevent hooking an adversary's stick from the opposite side of his horse; hitting across another horse's forelegs, etc. Penalties are free hits for goal given to offended sides from varying distances according to the severity of the foul, the umpire deciding. There is also a free hit from 60 yards given for a safety, that is, when a defending player strikes the ball over his own goal line wide of the posts. Before 1918, fractions of points were deducted for fouls.

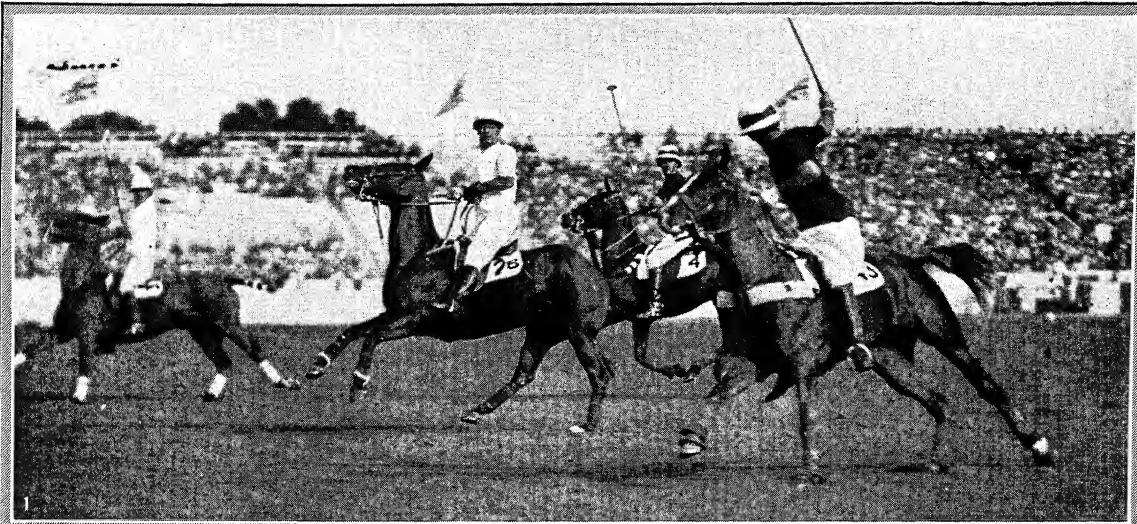
The ball to-day is made of willow root, the sticks used being, on the average, from 50 to 54 inches long, bamboo or malacca being popular as handles. The heads are cigar shaped wood, $8\frac{1}{2}$ or 9 inches long, the striking being done with the side of the head, not the ends. Leather hand grips are at the ends of the handles, with thongs to wrap around the wrists.

The game is very nearly as old in America as in England. James Gordon Bennett returned from a visit to England in 1876 with sticks and balls to introduce the game. Practice indoors that winter was followed by play outdoors in succeeding years, first at Jerome Park race track in Westchester County, then at 110th St., then at 156th St., present site of the New York National League baseball club and still called the Polo Grounds. In the late '70s and early '80s, play started on Long Island at Meadow Brook and Rockaway Hunting Club and at Newport. In 1886 the first international match was played at Newport and won by England in two straight matches. John Watson of England brought to the game in this series the backhand stroke which paved the way for the present fast play because it changed direction of the ball without turning the ponies.

For some years England employed an offside rule and limited the height of ponies to 14.2 hands. America never followed these rules and play was much faster in this country. After 1909, when this country's famous team, known as the Big Four, defeated England for the first time in international play, the offside rule was abandoned. After the World War, the height limit was forgotten. The end of the size limit has introduced thoroughbred blood into horse lines and tremendously increased the speed of the game. Polo to-day is a galloping, long hitting game, the players nominally being No. 1, attack and handler of opposing back; No. 2, goal hitter and more or less freelance; No. 3, pivotal player and defense man; back, last ditch defense but often to go through to the attack when possible, being covered by No. 3. But all players must be capable of assuming the others' duties when shifting of play brings changes of positions.

A system of handicapping was inaugurated by the United States in 1888 each player being assigned handicap goals on form, the four handicaps of any side being totaled and matched against the total of the other side, the difference being allowed in handicap at the start of the game. This was designed to

POLO



1. EDWIN LEVICK PHOTO; 2. WIDE WORLD PHOTO; 3. COURTESY METROPOLITAN MUSEUM OF ART

POLO PLAYERS, ANCIENT AND MODERN

1. International Polo Matches, 1927, first game. L. to R.: Stevenson, U. S., Milburn, U. S., Capt. George, G. B., and Maj. Atkinson, G. B. 2. 1930 Matches, Winston Guest of

American team, at start of backhand shot for goal. 3. Persian miniature of polo players. The game is believed to have originated in Persia.

make possible the mingling of experienced and beginner players. To date, 10 goals has been the highest individual handicap. Several have held this, and in 1931 three men in the world shared it, Lacey in Argentina, Capt. Roark in England, and Hitchcock in America.

Great Players of the World. Polo is played best in America, Great Britain and Argentina and, with slightly less skill, in Australia, China, Europe and practically over the entire world. Great players of the world through the game's history have included John Watson, Walter Buckmaster, F. M. Freake, L. St. C. Cheape, captain, Vivian Lockett, captain, C. T. I. Roark, captain, of Great Britain; Lewis Lacey of Argentina; Foxhall Keene, Lawrence Waterbury, Marty Waterbury, Harry Payne Whitney, Devereux Milburn, the last four The Big Four, Thomas Hitchcock, Jr., J. Watson Webb, Malcolm Stevenson and, most recent, Winston F. C. Guest, Eric Pedley, Earle A. S. Hoppling of the United States.

The governing body of the sport in the United States is the United States Polo Association, organized in 1890 with Meadow Brook, Rockaway Hunting, Country Club of Westchester, and the Philadelphia Country Club as the first elected members. In 1931 there were 94 member clubs of the association. A national championship has been held annually by the association since 1895, and international matches with Argentina as well as Great Britain; one in 1928 was won by America, two matches to one. The United States Army defeated the British Army twice in international matches in 1923 at Meadow Brook, two matches to one; and in 1925 at London, two matches straight.

The game is played indoors in cavalry armories and riding arenas during winter in New England, Middle Atlantic and Mid-West States. Three are on a side instead of four; a soft inflated ball is used, and there is fractional scoring of fouls. National championships are held each year by the Indoor Polo Association of United States, governing body. Outstanding players have included Winston Guest, Gerard S. Smith, Lt. McDonald Jones and Cyril Harrison.

INTERNATIONAL POLO RECORDS

For the International Polo Challenge Cup, presented in 1886 by the Westchester Polo Club of Newport, Rhode Island, U.S.A. *The best two out of three matches.*

- 1886 at Newport, R.I., U.S.A. Won by Great Britain, 10—4, 14—2.
- 1902 at Hurlingham Club, England. Won by Great Britain, 6—1, 7—1.
- 1909 at Hurlingham Club, England. Won by United States, 9—5, 8—2.
- 1911 played at Meadow Brook Club, U.S.A. Won by United States, 4½—3, 4½—3½.
- 1913 played at Meadow Brook Club, U.S.A. Won by United States, 5½—3, 4½—4¼.
- 1914 played at Meadow Brook Club, U.S.A. Won by Great Britain, 8½—3, 4—2¾.
- 1921 played at Hurlingham Club, England. Won by United States, 11—4, 10—6.
- 1924 played at Meadow Brook Club, U.S.A. Won by United States, 16—5, 14—5.

1927 played at Meadow Brook Club, U.S.A. Won by United States, 13—3, 8—5.

1930 played at Meadow Brook Club, U.S.A. Won by United States, 10—5, 14—9.

R. F. K.

POLONAISE, a national dance originating, as its name indicates, in Poland. In triple meter and moderate but vigorous tempo suggesting a march, it probably has its origin in ancient ceremonial processions. The form has been immortalized by the 11 pianoforte polonaises of Frederic Chopin.

POLONIUM, a chemical element belonging to the radioactive series of uranium and radium, discovered by the Curies in 1898. It bears the chemical symbol Po, has the atomic weight 210, and is formed from radium by the loss of four helium atoms and four electrons, and is also called radium F. Its time-period is 136.5 days. *See* RADIOACTIVITY.

POLTAVA, an important city in central Ukrainian S.S.R., on the Vorksla River. It was just outside the city that PETER THE GREAT defeated Charles of Sweden in the memorable battle of June 27, 1709. The site was mentioned in the 12th century as Ltava, and fell under Tatar domination in the 15th century. It was a revolutionary center under the rebel Bodan Chmielnicki. Situated in the heart of rich farming lands, Poltava is particularly notable for its sugar factories, numerous flour mills, and a bacon packing house. There is extensive manufacture of leather goods, much of which is disposed of at the annual fair. Among the featured sights are the Children's Small Town and the Proletarian Museum. Pop. 1926, 91,984.

POLTAVA or PULTOWA, BATTLE OF, July 8, 1709, a battle during the Russo-Swedish Wars, between the Russian army of 70,000 under Peter the Great against the Swedish army, numbering 24,000, led by Charles XII. The battlefield was at the Russian town of Pultowa on the Vorskla River. At the outset of the battle, the Swedes were successful in holding back their enemy but they were later overwhelmed by the superior numbers and heavy artillery fire of the Russians. More than half of the Swedish army was killed and wounded. Charles made his escape and fled to Turkey in order to persuade the Sultan to attack Peter; but his power was broken after his defeat at Pultowa. With it went the ascendancy of Sweden pushed aside by the growing power of Russia.

POLTERGEIST, in folk-lore, a noisy mischievous spirit believed to be responsible for strange sounds and even for the wrecking of objects. It is an ancient belief associated especially with haunted houses and the assumed return of uneasy spirits of the dead. Halloween (All Soul's Day) practices arise from a survival of this belief, which formerly was very widespread. *See* GHOST.

POLYANDRY, the system under which a woman has more than one husband at the same time. Polyandry exists among a few South American Indian tribes, among the Eskimo, in Tibet, the Malay Archipelago, certain parts of India, Africa, Madagas-

car and in some of the islands of the South Pacific. Frequently one husband, usually the first, is the chief mate. In the case of fraternal POLYGYNY, where one woman is married to several brothers, the eldest ranks highest. This type of polygyny is prevalent in Tibet and in sections of southern India. Both polygyny and polyandry are practiced in some Eskimo tribes. Polygyny is said to exist more readily among peoples having a preponderant male population.

POLYBIUS (c. 204-c. 122 B.C.), Greek historian, born at Megalopolis in Arcadia. In 182 B.C. he succeeded his father Lycortas as head and general of the Achaean League. In 171 B.C. he persuaded the Achaeans to seek an alliance with Rome, which was then at war with MACEDONIA. After defeating Macedonia the Romans, to safeguard their interest in Achaea, secured 1,000 Achaean hostages, among them Polybius. Polybius for the next 17 years, then, remained in Rome, not under restraint as the other hostages, but on terms of intimacy with the family of Aemilius Paulus, and more especially of SCIPIO the Younger, who gathered about him a literary circle including TERENCE, LUCILIUS, and others. As a friend of Scipio, Polybius later was present at the siege and capture of CARTHAGE 146 B.C. His later years were devoted to persuading the Achaeans to accept Roman rule. Polybius wrote a history in 40 books, having as its purpose to relate the manner in which and to explain the reasons for which Rome in the short span of 53 years 220-168 B.C. acquired such a mighty

empire. Of this history only the first five books are preserved entire, but we have large portions of the remainder. In book six he makes a valuable critical analysis of the Roman constitution, and elsewhere he describes Rome's military methods.

POLYCHROMY, sculpture in several colors. From ancient times it has entered into architectural ornamentation, subordinating itself and contributing to decorative color value, through the motif in silhouette or in outline carved in relief. The chryselephantine statues of Phidias are indicative of the prevailing use of chromatic material. Monochrome sculpture of the Egyptians, Greeks and Byzantines was elaborately painted in brilliant colors,



THE LANCE-BEARER
In the Naples Museum

with jewels and headpieces brushed on in gold. The portrait bust in tinted marble was revived in the 19th century, in France by Gérôme, and in America by Herbert Adams.

POLYCLITUS, one of the three great Greek sculptors of the 5th century B.C. He worked in bronze exclusively, specializing in the statues of athletes. His great contribution was the *Polyclitan stance*, wherein the weight is thrown on one foot, instead of on the two feet equally as in the archaic style. He also published a treatise on the proportions of the human figure. Some of his celebrated statues were the *Doryphorus*, or Lance-bearer, the *Diadumenos*, or Youth with the Fillet, and the *Wounded Amazon*, a colossal chryselephantine statue of Hera for the temple at Argos. No originals have survived; but we have late copies of six or more of his works. The best preserved copy is one of the *Doryphorus* in marble found at Pompeii.

POLYGALA, a very large genus of plants of the family *Polygalaceae*, commonly known as milkworts. There are more than 500 species distributed almost throughout the world; about 50 occur in North America. They comprise herbs, shrubs or rarely trees with simple, entire leaves, irregular, often showy, flowers, borne singly or in clusters, and capsular fruits. Several species are grown for ornament. The dried root-stocks of the SENECA SNAKEROOT (*P. Senega*) are used medicinally. See also MILKWORT.

POLYGAMY. See POLYGYNY.

POLYGON, a word meaning originally many-angled. It is commonly applied to a plane closed rectilinear figure of more than four sides, but geometrically considered it also includes triangles and quadrilaterals. A spherical polygon is a closed figure whose sides are arcs of great circles. Polygons may be classified according to the number of sides. See TRIANGLE; QUADRILATERAL; PENTAGON; HEXAGON.

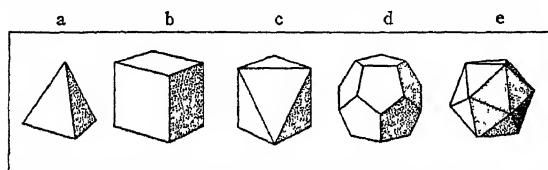
POLYGONUM, a large genus of herbaceous plants of the buckwheat or knotweed family. There are some 200 species, widely distributed throughout the world but most numerous in temperate regions, several of which are grown as ornamentals. Among those most widely cultivated are the princes-feather (*P. orientale*), the Japanese knotweed (*P. Sieboldi*) and the sacaline (*P. sachalinense*). See also KNOTWEED; PRINCES FEATHER.

POLYGYNY or **POLYGAMY**, the marriage of one man to several legal wives at the same time. The word more generally used, polygamy, means literally many marriages, and may thus include the practice of Polyandry, but its actual sense is commonly restricted to that of the less popular but more accurate term polygyny, meaning many women. Polygyny was permitted among the ancient Hebrews, but forbidden to the Romans and Greeks. Among the Egyptians and Babylonians it appears to have been practiced only slightly. In Christian Europe cases of polygyny existed in medieval times, notably that of Charlemagne with his two wives. Mohammed ruled that his followers might each take wives to the number of four. Polygyny was one of the freedoms insisted upon by the Anabaptists in Germany in the 16th century.

In modern times the most conspicuous advocacy of

the system has been among the Mormons, who formally abandoned it in 1890. Unlimited plural marriage is permitted to Hindus, but modern custom tends to discourage it. Polygyny is unlawful in China and Japan. It is common among uncivilized peoples in Australia and Polynesia and is the general rule among the African native tribes, although some African Pygmy peoples are said to be monogamous. Although polygyny as a system has been and is widespread among the peoples of the earth, it is actually practised by only a small minority, estimated as being rarely over 5% in countries where it is permitted. Among primitive masses it is too expensive a luxury, while by the more advanced and better educated it is generally discouraged.

POLYHEDRON, a solid bounded by planes. The most important polyhedrons are the PRISM, of which the rectangular solid, the cube, and the general parallelepiped are types; the PYRAMID, and the five regular



CLASSES OF POLYHEDRONS

(a) Tetrahedron, (b) Hexahedron, (c) Octahedron, (d) Dodecahedron and (e) Icosahedron

polyhedrons. A regular polyhedron is one whose faces are congruent regular polygons and whose polyhedral angles are equal. The five regular polyhedrons are illustrated herewith.

POLYHYMNIA or **POLYMNIA**, in Greek mythology, one of the nine Muses.

POLYMERIZATION, the name given to the process in chemistry whereby two or more molecules of the same substance may unite to form a much more complex molecule, possessing different chemical and physical characteristics. *Polymerism*, which is a special aspect of *isomerism*, is said to exist between two substances if the molecular formula of the one is a simple multiple of that of the other, regardless of the fact whether the simpler substances can be made to polymerize into the more complex one. Among the best known examples are the polymerization of formaldehyde, CH_2O , into paraldehyde, $(\text{CH}_2\text{O})_3$, and ultimately into a sugar, $\text{C}_6\text{H}_{12}\text{O}_6$; that of acrolein, and aldehydes in general, into resin-like substances, and that of isoprene, C_5H_8 , into rubber, which possesses a very complex structure. If the two polymeric substances bear little or no resemblance to each other, the polymerism is often described as accidental, as in the case between acetic acid CH_3COOH , or $\text{C}_2\text{H}_4\text{O}_2$, and glucose, $\text{C}_6\text{H}_{12}\text{O}_6$. See also CONDENSATION.

W. J. L.

POLYMNIA. See MUSES.

POLYMORPHISM, in biology, used broadly, a term signifying the occurrence in a single kind or species of animals or plants of groups of individuals which differ significantly in form, structure or color.

Among animals which reproduce sexually a degree of sexual dimorphism is commonly present. The term is best applied only when the differences between the sexes appear as secondary sexual characters (*see* SEX). Often these are extreme. Occasionally within the one or other sex polymorphism is found.

Dimorphism or polymorphism of a different type is also encountered between successive periods of a life cycle. A larva may differ greatly from the adult. In ALTERNATION OF GENERATIONS extreme dimorphism often marks the antithetic or strongly contrasted phases of the life cycle.

Instances of a seasonal polymorphism are to be noted, particularly among insects as shown in the color pattern. A regional polymorphism may distinguish varieties or subspecies.

True polymorphism occurs among colonial forms (coelenterates) and in the social insects,—termites, ants, bees and wasps. The groups of individuals express a division of labor in the colony or social state. The Portuguese Man-of-war strikingly illustrates polymorphism in the colonial group. Ants, often with as many as six castes in the social community, mark the highest development of polymorphism. The honeybee is a familiar example with its three groups, drones or males, the queen, a female and workers, the undeveloped females.

B. F. K.

POLYNESIA, the easternmost division of Oceania, consisting of widely scattered groups of small islands or atolls extending from Micronesia and Melanesia eastward as far as 130 E. long. The most important group is the Hawaiian Islands, a territory of the United States. Others are Tonga, Samoa, the Society Islands including Tahiti, the Ellice group, the Marquesas, and all intervening groups. The limits of this division are drawn on ethnological rather than political or geographical lines, for which reason it is sometimes extended to include New Zealand where a part of the population is of Polynesian extraction. The natives are a distinctive, brown-skinned people of undetermined Asiatic origin.

POLYNESIAN, division in anthropology. See RACES OF MANKIND: Other Groups.

POLYNESIAN, a group of the MALAYO-POLYNESIAN linguistic family spoken in the Samoan, Society, Tongan, Hawaiian, Cook, Tuamotu, Gambier, Chatham and Marquesas Islands, Easter Island, New Zealand, etc. Except for some pictographic (*see* PICTOGRAPHS) records from Easter Island, none of its members has been reduced to writing except by Europeans. Closely related to INDONESIAN, the group is characterized phonologically by reduction and loss of consonants; the noun is inflected by propositions, or its case is indicated by simple position; the personal pronouns have singular, dual and plural numbers, with inclusive and exclusive forms for the first person plural ("we, including you," "we, but not you"); and the verbs include not only the usual transitive, intransitive, passive, causative, desiderative and reciprocal types, but also categories denoting nearness, distance and direction of action, besides both absolute

and conditional affirmation. The numerical system is decimal. L. H. G.

BIBLIOGRAPHY.—F. Müller, *Grundriss der Sprachwissenschaft*, II, ii, 1882.

POLYNICES, in Greek mythology, son of OEDIPUS, King of Thebes, and Jocasta, was brother of ETEOCLES and ANTIGONE. After Oedipus's death, the brothers tried to rule Thebes in alternate years, but Eteocles drove out Polynices who, obtaining the help of Adrastus of Argos and five other heroes, led the expedition known as 'The Seven Against Thebes'. In this war the two brothers killed each other.

POLYNOMIAL, any mathematical expression consisting of two or more terms connected by signs of addition (+) or subtraction (−), such as $a + bx - cy$. The BINOMIAL is a special kind of polynomial.

POLYNOMIAL THEOREM, a rule for finding the coefficients of a polynomial raised to any power whatsoever. When the polynomial

$$x_1 + x_2 + x_3 + \dots + x_n$$

is raised to the power S , the coefficient of the term containing $x_1^{a_1} + x_2^{a_2} + \dots + x_n^{a_n}$, in which

$$a_1 + a_2 + \dots + a_n = S,$$

will be

$$\frac{S!}{a_1! a_2! a_3! \dots a_n!}$$

The theorem was first stated in a letter by Jean (Johann, John) Bernoulli to Leibnitz, dated June 4, 1695.

See D. E. Smith, *Source Book of Mathematics*, 1929.

POLYP, NASAL. See SINUSES AND SINUSITIS.

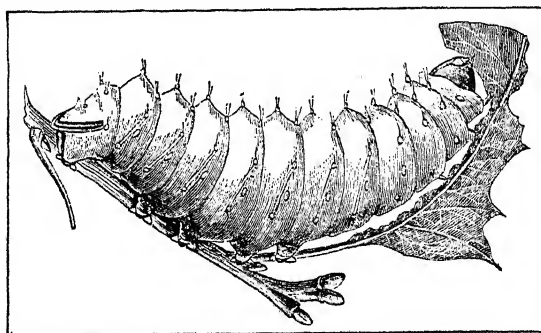
POLYPHASE CIRCUIT. See PHASE, ELECTRICAL.

POLYPHEMUS, in Greek mythology, the chief Cyclops, son of POSEIDON and Thoosa, was of great size and had only one eye. He lived in a cave in Sicily, and when Ulysses and his companions were shipwrecked there, the Cyclops seized and devoured many of them. Ulysses, by making the giant drunk and blinding him, was able to escape with the rest of his comrades by clinging beneath the sheep as they left the cave to graze. Ulysses's later disasters were said to be punishments inflicted by Poseidon to avenge his son's blindness. Polyphemus loved the nymph GALATEA.

POLYPHEMUS MOTH, one of the common species (*Telea polyphemus*) of the family of giant silk-worms, *Saturniidae*. Wings are yellowish brown in color, with a clear "window" in each wing, surrounded by yellow and black wings. Full-grown larvæ are light green in color, with oblique yellow lines on the sides of the body. They have small orange tubercles. They feed on many kinds of trees. Cocoon is of dense silk, enclosed in a leaf.

POLYPHONY, in music, a word meaning literally "many sounds," descriptive of those musical compositions in which simultaneous tones are regarded individually or as separate elements, rather than as subservient parts of a chord or harmonic unit.

All musical compositions may be broadly divided into two classes: 1. homophonic, in which tones are treated chordally, and 2. polyphonic, in which the tones are accorded independence and, while coming together in harmonic combinations, are ideally regarded as separate entities; or, with greater accuracy, as parts of different voices which are separate. Few types of composition follow either of these two methods exclusively, since homophony and polyphony are frequently mingled, but this classification of gen-



LARVA OF POLYPHEMUS MOTH

eral tendencies is nevertheless accurate. Historically viewed, polyphony is inferior to homophony provided that evolution is interpreted as movement; for polyphonic music had reached a fairly high stage of development in the 14th, 15th, and 16th centuries, whereas homophonic music did not reach maturity until the 17th and 18th centuries. Considering the continual growth of the harmonic sense during the past century, one may question whether it has even yet reached its full stature. But aside from these genetic considerations there can be no doubt that polyphony is intellectually superior, calling into play, as it does, the highest ingenuity of the composer and the keenest concentration of the auditor, especially when taking the form of FUGUE and CANON, both of which are special studies in the art of COUNTERPOINT.

POLYPODY, the common name for an immense genus (*Polypodium*) of true ferns, a few of which are grown as ornamentals. There are about 600 species, natives chiefly of tropical and subtropical regions; a limited number are found in temperate climates, some so occurring in the United States. While in the tropics some are perching plants (epiphytes) growing upon trees, the great majority are terrestrial with prominent branching rootstocks, whence the name polypody, signifying many feet. The leaf-stalks (stipes), which are jointed to the rootstock, bear entire or pinnately lobed leaves (fronds) with large roundish naked fruit dots (sori) on the under surface. Among the best known are the common polypody or wall fern (*P. vulgare*) of the Old World with many foliage varieties in cultivation; the golden polypody (*P. virginianum*), of wide distribution in North America; the western polypody or licorice fern (*P. occidentale*) of the Pacific coast, and the gray polypody (*P. polypodioides*) of the southern states. See also HARE'S FOOT FERN.

POLYPUS, a small tumor projecting into a cavity and attached by a narrowed base or peduncle. The mucous polyp of the side wall of the nose is the most usual form. Such a structure is composed of mucoid connective tissue covered by the mucous membrane lining the nose. It arises as a response of the tissues to the constant irritation of pus from an infected sinus. Another type of polypus projects into the nose from its roof. Polypi may project into the middle ear, the rectum, the urethra or the uterus. In some of these cases they are irritative in origin and in others they merely are one of the forms taken by tumors or other types. The usual treatment of polypus is removal, either by the snare or by the electrocautery.

POLYTECHNIC INSTITUTE OF BROOKLYN, at Brooklyn, N.Y., a privately controlled, non-sectarian, technical school for men was an outgrowth of the Brooklyn Collegiate and Polytechnic Institute founded in 1853. The present title was assumed in 1889, and in 1908 the course in arts was dropped. The institute gives college training in chemistry, and in chemical, civil, electrical and mechanical engineering, and day and night classes are held. It had productive funds in 1931 amounting to \$1,040,400. The library contained 16,000 volumes. In 1931-32 there were 2,121 students and a faculty of 32, headed by Pres. P. R. Kolbe.

POLYTHEISM, a form of religious belief holding to the existence of many gods. Usually these gods have strikingly human characteristics; hence polytheism is essentially anthropomorphic. There is also a close connection between polytheism and MYTHOLOGY, the great mythologies having to do with gods and semidivine heroes. Natural processes at this stage have become personified and the various realms of nature are ruled by special gods. These gods are different from spirits, in that they are both more concrete and more abstract. On the one hand the spirit is vague and ill-formed; the god is definite and fairly well-shaped in the minds of its worshippers. On the other hand, a spirit is usually confined to a local habitation; a god is free from this limitation and covers a wider range of territory.

Originally the gods represented some outstanding object or some important process of nature. Zeus was the sky god, Neptune the god of the waters, Thor the thunder god, Mars the god of war, while Demeter and Venus were goddesses of fertility. Thus there was a division of labor even among the gods. The sky was usually represented by the male, the earth by the female principle. We still speak of the Father in heaven and refer to Mother Earth.

POLYXENA, in Greek mythology, a daughter of PRIAM and HECUBA, promised in marriage to ACHILLES. One legend says that she committed suicide on hearing of Achilles's death, another that she was killed by NEOPTOLEMUS at Achilles's tomb.

POMEGRANATE (*Punica Granatum*), a handsome shrub or small tree of the pomegranate family, prized since earliest times for its edible, acid fruit. It is a native of Asia long cultivated and widely nat-

uralized in tropical and subtropical regions. In the southern United States, where it is sparingly naturalized, it is grown on a commercial scale and also planted as an ornamental. Though usually somewhat bushy in habit, the pomegranate occasionally becomes a tree 20 ft. high. Its many slender, somewhat thorny branchlets bear smooth shining leaves, orange-red flowers, an inch or more across, and globular fruits, about the size of an orange, with a tough, leathery rind of a brownish-yellow color tinged with red. The fruits, which contain numerous seeds each surrounded by a separate layer of reddish pulp, are eaten as a dessert or made into a cooling beverage.

POMERANIA, a province of northern Prussia on the Baltic Sea. Its area is 11,663 sq. mi. and its population (1925) 1,877,324. Farming and fishing are the principal industries, important agricultural crops being potatoes, oats and rye. The country is flat and the soil infertile in most sections.

POMME DE PRAIRIE (*Psoralea esculenta*), a stout, rough-hairy perennial of the pea family called also *pomme blanche* and prairie turnip. It is native to prairies from Manitoba and Saskatchewan southward to Texas. The slightly branched stem, rising 4 to 18 in. high from a large farinaceous root, bears long-stalked leaves composed of five digitate leaflets and a dense, oblong spike of small, bluish flowers. The root was extensively used for food by the Indians and the early travelers and explorers.

POMO, an American Indian tribe and linguistic stock, also known as Kulanapan, a member of the combined Hokan family. The Pomo lived in California, in parts of Sonoma, Lake, Mendocino, Colusa and Glenn counties. Pomo consists of seven dialects: one found in the Sacramento Valley, two near Clear Lake, one in the southern part of their coastal territory, one to the lower Russian River, and two occupy parts of the interior valley along Russian and Eel rivers and parts of the coast. Perhaps of all the numerous California tribes, the Pomo are best known for their coiled basketry, finely made and often feather-decorated. Their unit of political organization was the village. Unlike most of the more southerly California tribes, the Pomo were not brought under the authority of the missions. About 2,000 of them still live in their aboriginal habitat, either as squatters or on allotted land purchased for them by the Government.

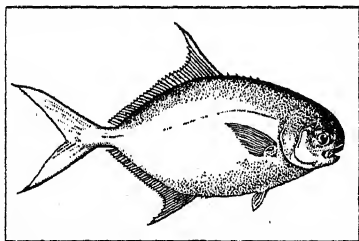
POMONA, in Roman mythology, goddess of fruit trees. A grove near the road to Ostia was said to be sacred to her. She was loved by Vertumnus, the god who ripens the fruits, but it was long before she responded to his wooing. When he finally won her they were ever after inseparable.

POMONA, a city in Los Angeles Co., southern California, 33 mi. east of Los Angeles, served by buses, three railroads and the Pacific Electric Railway. There is an airport. Pomona is an important shipping point for a region producing citrus and deciduous fruits, walnuts, hay and grain. The chief local industries are fruit canning and the manufacture of

pumps, paper, bricks and tiles. The manufactured output, 1929, was worth \$5,042,702. In 1929 the retail business amounted to \$13,666,015. Pomona was settled by the Spaniards in 1837, Americans first coming there in 1850. The town received its present name in 1875 and was incorporated in 1888. The Los Angeles County Fair is held in the city. Kellogg Arabian Horse Ranch and Carnation Stables are located here. Claremont, in the vicinity, is the seat of Pomona College. Pop. 1920, 13,505; 1930, 20,804.

POMONA COLLEGE, at Claremont, Cal., a co-educational institution, was incorporated in 1887. It is privately controlled and non-denominational, although it was begun under the influence of the Congregational Church. In 1925 Pomona College incorporated as one of the Claremont Colleges (see SCRIPPS COLLEGE) in accordance with plans for development which call for the building of a group of colleges in the same academic community. It had productive funds in 1931 amounting to \$2,831,299. The Carnegie Library of 68,089 volumes contains the Mason Collection of California and Western American History, and the Mavor Collection of Russian Social and Academic History. In 1931-32 there were 838 students and a faculty of 81, headed by Pres. CHARLES K. EDMUNDS.

POMPANO, or *pampano*, a highly prized food fish belonging to the crevally family (*Carangidae*), is found on the Atlantic coast of the United States from Cape Cod to Florida, but generally in southern waters and south to Brazil. Its slender, oval, compressed body, from 18 to 36 in. long, is blue above and silver below. Pompanos are not game fish because of their



POMPANO

small mouths and their unwillingness to strike at bait. Fishermen catch them with seines during the spring when they come to the shallower waters to spawn and in the fall when they again form in large schools. They are caught all year 'round on the Florida coast. The common pompano (*Trachinotus carolinus*), weighing from 2 to 5 lbs., brings the highest price in the markets. Another variety, the permit, or great pompano (*T. goodei*) occurs in the West Indies and reaches a weight of 27 lbs.

In 1929 the total commercial catch of pompano in United States waters, taken almost entirely on the south Atlantic and Gulf coasts, amounted to 533,000 lbs., valued at \$111,000.

POMPEII, an ancient city of Campania in Italy on the Sarnus River. Located at the foot of Mt.

Vesuvius, it was midway between Herculaneum and Stabiae. The city went back to the 6th century B.C., when it was founded by the Oscans. From 349 to 290 it was engaged in the Samnite Wars. Under Sulla Pompeii became a Roman colony, or municipium. In 63 A.D. Pompeii was the victim of an earthquake and had not recovered from the effects of this disaster when it was destroyed, along with Herculaneum and Stabiae, by the great eruption of Vesuvius in 79. About 2,000 of the 20,000 citizens of Pompeii perished as the result of this catastrophe. Many of the riches of Pompeii were lost when its survivors returned to the site of the buried city after the eruption, dug down to its remains and carried away as many valuable possessions as could well be obtained. But the remains of the buried city throw an interesting light on life in a Roman city during the first century A.D. Centuries elapsed before efforts were made to unearth the ruins. During the Middle Ages the site was practically abandoned. In 1592 an aqueduct, which intersected the ruins, was built. But it was not until nearly a century and a half later that interest was revived in the old site. In 1748 active and systematic excavations were begun under Charles III of France. The crust of ashes, volcanic matter and soil over the city averaged between 18 and 20 ft. thick. About half of Pompeii has been uncovered, considered the most interesting and instructive part of its ruins.

Among the buildings of note are the forum, around which the life of the city centered; the amphitheater, capable of accommodating 20,000 spectators; the two theaters close together, the largest with a capacity of 5,000; the seven temples, one to Jupiter, another to Apollo and a third to Isis; the three public baths and the four public buildings near the forum. The streets were paved and the houses were mostly two-story structures.

POMPEY (GNAEUS POMPEIUS) (106-48 B.C.), Roman general and statesman. At the age of 17 he served in the SOCIAL WAR. In the civil war between SULLA and Marius he favored Sulla, in 83 B.C. winning a victory over the Marians. After five years of service in Spain against Sertorius, a Marian leader, in which he was eventually successful, Pompey in 71 B.C. won the final victory over the slaves, whom SPARTACUS had led in revolt. In 70 B.C. he was consul, and three years later he brilliantly suppressed piracy in the Mediterranean. In 66 B.C. he took command of the war against MITHRIDATES, bringing it to a successful termination, and in 64-63 B.C. he annexed Syria and Palestine to the Roman empire. Laying aside the extraordinary powers granted to him for the conduct of the Mithridatic War, Pompey returned to Rome, where he soon, 60 B.C., formed with Caesar and Crassus a coalition known as the first triumvirate. To cement this alliance Pompey married Julia, the daughter of Caesar. While Caesar was occupied in the conquest of Gaul, 59-49 B.C., Pompey was in almost complete control of Rome. The death of Julia, 54 B.C., and the defeat and death of Crassus, 52 B.C., caused

the relations between Pompey and Caesar to become less friendly, and their differences finally led to war. When Caesar crossed the Rubicon, 49 B.C., Pompey, followed by a majority of the Senate, withdrew to Epirus, whither Caesar followed him, administering a complete defeat to the Pompeian forces at Pharsalus in Thessaly, 48 B.C. Fleeing to Egypt, Pompey was treacherously murdered as he was landing. Pompey was a good soldier, although no match for Caesar. As a statesman he must be regarded either short-sighted or else, which seems less probable, a patriot whose acts of self-renunciation bore the appearance of cowardice and stupidity.

PONCA, a North American Indian tribe forming with the Omaha, Osage and Kansa the Upper Dhegiha or Omaha division of the so-called Dhegiha group of the Siouan linguistic stock. Linguistically they are most closely related to the OMAHA. They formerly lived in the region of the Niobrara River in southern South Dakota and northern Nebraska. In 1877 they were forced to move to Oklahoma, where the majority of the survivors now reside.

PONCA CITY, a city in Kay Co., northern Oklahoma, situated on the Arkansas River, about 100 mi. northeast of Oklahoma City. Bus and truck lines and two railroads afford transportation. Ponca City is an air mail port, with modern equipment and fire-proof hangars. Oil is found in this region. The city is a shipping market for the grain raised in the vicinity, and a manufacturing center, producing gasoline, kerosene and other oil products. The retail business, 1929, was valued at \$9,530,438. Ponca City was founded in 1893, when the government opened Cherokee Strip. Interesting features in and around the city are the Indian tribes and Indian schools, the famous 101 Ranch, the Pioneer Woman statue, and the Wentz outdoor swimming pool. Pop. 1920, 7,051; 1930, 16,136.

PONCE, the most important Carribean port on the southern coast of Porto Rico. The city has communication with the rest of the island by steamer, and bus lines over the Spanish Military Road. It has the most abundant water supply in Porto Rico.

Ponce is attractive with quaint Spanish houses and gardens, the sea on the south and hills with beautiful villas on the north. It was the first city within the Spanish empire to build a Protestant church. Queen Victoria requested Spain to grant this privilege to British subjects living there. The city has public and private schools; a thoroughly modern hospital, St. Luke's Memorial; and a tuberculosis sanatorium. Besides the native industries of tobacco and sugar, there is a widely known diamond-cutting factory. Pop. 1920, 19,124; 1930, 53,430.

PONCE DE LEON, JUAN (c. 1460-1521), Spanish explorer, was born in Leon, Kingdom of Castile, about 1460 and while still a young man became a tutor attached to the Royal household. He interested himself in exploration, sailed with Columbus on his second voyage in 1493, and in 1510 was appointed Governor of Porto Rico. Relieved shortly of this post

he fitted out three ships in 1513 and set off to the northeast, searching for a fabulous curative fountain. Reaching Florida, Ponce de Leon gave it its name. After a visit to Spain he returned to Porto Rico in 1515 and in 1521 fitted out two ships and attempted to found a settlement in Florida, apparently at Charlotte Harbor on the Gulf Coast, but Indian attacks ruined the scheme and Ponce de Leon, wounded, set sail for Porto Rico and died on the voyage.

PONCHIELLI, AMILCARE (1834-86), Italian music composer, was born at Paderno Fasolaro, Aug. 31, 1834. After studies at Milan Conservatory he brought out his opera *I promessi Sposi* in 1856. It was followed by several other operatic works, the only one of which to achieve wide recognition being *La Gioconda*. He died at Milan, Jan. 16, 1886.

POND, a small body of water filling a depression in the land. Freshwater ponds sometimes result when sandbars close lagoons on the seacoast, drainage gradually rinsing out the salt. Ponds also collect in kettle-holes in a glacial moraine. Otherwise their formation depends upon causes operative also for LAKES.

PONDWEED, a numerous genus (*Potamogeton*) of aquatic perennial herbs of the pondweed family. There are about 90 species widely distributed in temperate regions. They are chiefly fresh-water plants with creeping rootstocks and branching stems, a foot to several feet long, bearing oblong, leathery floating



COURTESY IOWA GEOL. SURV.

COMMON PONDWEED

(*Potamogeton natans*) Apex of a plant in flower and a single flower from above and from side

leaves, and very narrow submerged leaves. The small greenish or reddish flowers, usually borne in simple spike just above the surface, are followed by drupe-like fruits. The pondweeds are common everywhere in still water, sometimes impeding navigation in canals. The herbage and fruits provide food for numerous water birds and aquatic insects.

PONDYCHERRY, capital of French India and of the colony of Pondyicherry, situated on a sandy flatland about 80 mi. southwest of Madras. It comprises a native and a European quarter, the latter containing a beautiful square flanked by the public buildings and government institutions. The city is the center of the cotton industry of French India. There are three cotton mills and quantities of cot-

ton stuffs are exported every year. Other exports include oil-seeds, peanuts, fish, hides and indigo. Pondycherry was taken by the French in 1683. Several times it passed into the hands of the British but was definitely restored to France in 1815. Pop. 1929, city, 47,626; province, 188,000.

PONS, LILY (1904-), French coloratura singer, was born at Cannes in 1904. She studied the piano at the Paris Conservatoire, and in 1925 began vocal instruction. After studies with Alberti in Paris she made her début in 1926 in a performance of *Lakmé* at Mulhausen. During 1927-29 she sang in small opera companies in Europe. Her phenomenal vocal range and her dramatic endowments led to an invitation to join the Metropolitan Opera, New York, where she made her début on Jan. 3, 1931, singing Gilda in *Rigoletto* with pronounced success. Her popular rôles are as Gilda, Lucia and Philine in *Mignon*.

PONSELLE, ROSA MELBA (1897-), American soprano, was born at Meriden, Conn., Jan. 23, 1897. Her first professional appearances were at the Meriden "Nickelodeon," which were followed by vaudeville performances with her sister, Carmela. In 1918 she began to study singing with Romano Romani, and in only six months, on Nov. 15, 1918, made her début at the Metropolitan Opera, New York, singing Leonore opposite ENRICO CARUSO in *La Forza del Destino*. Her voice developed a phenomenal range, enabling her to sing dramatic, coloratura and mezzo rôles with equal facility. Her best performances have been in *Norma*, *La Traviata*, *La Gioconda*, and *Don Giovanni*, appearing in the latter at its revival during the 1930-31 season of the Metropolitan Opera.

PONTA DELGADA. See AZORES.

PONTCHARTRAIN, LAKE, a landlocked salt-water bay in southeastern Louisiana directly north of New Orleans. It is about 40 mi. long, 24 mi. wide, and has a central depth of 16 ft. which decreases uniformly to about 6 ft. near the shore. To the east it communicates with Lake Borgne and Mississippi Sound by the Rigolets Pass through which the tide enters. Its south shore is within 5 mi. of the Mississippi River at New Orleans, with which it is connected by the New Orleans Industrial Canal. The lake is important chiefly as a secondary harbor for New Orleans.

PONTE, LORENZO DA (1749-1838), Italian poet, was born at Ceneda, Mar. 10, 1749. He held the post of Poet at the Vienna Imperial Theatre, where he met Mozart, and wrote for him the librettos of *FIGARO*, *DON GIOVANNI* and *Così fan tutte*. Subsequently he fled from his creditors to New York City, where he taught Italian at Columbia University. Ponte died in New York, Aug. 17, 1838.

PONTEFRAC, a municipal borough in the West Riding of Yorkshire, England, lying on an eminence near the confluence of the Calder and Aire rivers, about 167 mi. northwest of London. Of the Norman castle where Richard II died but little remains, and below it the contemporary Church of All Saints has also suffered from the castle's many

sieges. Liquorice is abundantly grown in the region and made into the famous "Pontefract loyenges." There also are foundries, tanneries, breweries, corn-mills, terra cotta and brick works, and sack and matting manufactures. Pop. 1921, 16,790; 1931, 19,053.

PONTE VECCHIO, a medieval bridge crossing the Arno River in Florence, Italy. Built in 1355 and mounted on three graceful stone arches, it is one of the most picturesque bridges in Europe, being bordered on either side by the small shops of goldsmiths and jewelers. On the south side, there is an overhead gallery connecting the Uffizi Palace and the Pitti Palace.

PONTEVEDRA, a city of Spain, capital of Pontevedra province, located at the mouth of the Lerez River. It has a Roman bridge, old city walls, a Gothic church, a 12th and 13th century bishop's palace, and a harbor. The city produces leather, cloth and hats, and there are also sardine fisheries and canning factories. Est. pop. 1929, 28,000.

PONTIAC (c. 1720-69), American Indian chief, was born in northwestern Ohio about 1720. By 1755 he was a chief of the Ottawa tribe. Encouraged by promises of help from the French, he organized a union of Indian tribes living between Lake Superior and the Gulf coast in a conspiracy, intending to drive out the English settlers and reclaim the region for the Indians. In 1760 the forts surrendered by the French were occupied by English troops; the Indians found English rule inhospitable, presaging their ultimate dispossession from their hunting grounds by English settlers. Pontiac enlisted the support of virtually all the tribes from Lake Superior to lower Louisiana. There were 14 English forts on the frontier; he arranged that on a concerted day in May 1763 each tribe should attack the fort nearest it. The attacks were successful in ten instances. Pontiac's scheme to capture Ft. Detroit was betrayed, whereupon he laid siege to the post. The Indians became restless at the protracted siege, many deserting; reinforcements entered the garrison; and when his hopes of French aid were removed by news of the Peace of Paris (see FRENCH AND INDIAN WAR), Pontiac raised the siege. Col. Henry Bouquet, who had successfully defended Ft. Pitt, led an expedition into Ohio which cowed Pontiac's allies. On Aug. 17, 1765 Pontiac made a formal treaty of peace. Within two years the tribes submitted to the English and Pontiac agreed to a peace treaty. He was killed at Cahokia, Ill., in 1769 by an Illinois Indian said to have been bribed by an English trader.

PONTIAC, a city in northeastern Illinois, the county seat of Livingston Co., situated on the Vermilion River, 92 mi. southwest of Chicago. Three railroads serve the city, which is a shipping point for farm produce. Pontiac has chicken hatcheries and factories producing chiefly shoes and automobile accessories. Founded in 1837, Pontiac was incorporated in 1872. Pop. 1920, 6,664; 1930, 8,272.

PONTIAC, a city of southeastern Michigan, the county seat of Oakland Co., situated on the Clinton

River, about 25 mi. northwest of Detroit. The Grand Trunk Railroad, electric railways, bus lines and a municipal airport afford transportation. Built at an elevation of 1,000 ft., Pontiac is in the heart of a picturesque summer resort region of small lakes and streams where fishing is excellent. Of the 400 spring-fed lakes in Oakland Co., Orchard Lake, the largest, is 6 mi. southeast of the city. Scenic drives radiate in every direction, passing fine estates and attractive camp locations. Pontiac is in an agricultural district and ships fruit and wool. But the chief manufacture is automobiles; among the other products are taxicabs, buses, trucks and rubber. In 1929 the factory output was worth about \$275,000,000. The retail business in 1929 amounted to \$44,461,036. The city was laid out by Stephen Mack in 1818 and named for the great Indian chief Pontiac, who made his headquarters among the nearby lakes when he besieged Detroit in 1763. Pontiac was made a county seat in 1820, was incorporated as a village in 1837, and in 1861 received a city charter. Pop. 1920, 34,273; 1930, 64,928.

PONTIAN, ST. (3rd century), Bishop of Rome, 230-235. During the reign of Alexander Severus, who was friendly to the Christians, Pontianus was well treated; but the Emperor Maximinus had him exiled to Sardinia, where he suffered great hardships. In order that another pope might be elected he resigned and was succeeded by Anteros. He died in Sardinia; but Fabian had his remains taken to Rome and buried in the Catacomb of Callistus.

PONTIFEX MAXIMUS, the head of the sacred college of Roman priests. As the chief religious officer of the Roman world, the Pontifex Maximus possessed a tremendous power, so much in fact that the emperors finally took over the office for themselves. Thus Caesar acquired the office, and Augustus did likewise. The later emperors accepted the office as a matter of course. The Pontifex Maximus was ex-officio head of the Roman state religion.

PONTIUS PILATE. See PILATE, PONTIUS.

PONTUS, Kingdom of, a region of northeast Asia Minor bordering on the Euxine and extending to the Halys River. The kingdom was founded in the 4th century B.C. and lasted until 62 A.D., when it was made a province of the Roman Empire by Nero. It was then divided into three parts for purposes of administration. During the days of the kingdom its greatest monarch was Mithradates VI. Its inhabitants were known as the White Scythians.

POOD, a Russian unit of weight, equivalent to about 36 POUNDS avoirdupois.

POOL, or pocket-billiards, a game played on a billiard table 5 by 10 feet or 4½ by 9 feet in dimension, equipped with six pockets. The game is a popular offshoot of American billiards, requiring appreciably less skill than the latter sport. Pockets are set in all four corners, and two in the center of the side cushions. By a gully device, the balls, when pocketed, drop down a slide-way, and are conveniently returned to a tray at the end of the table. The various

forms of pool are played with billiard cues and colored balls, each bearing a numeral. These object balls are struck with a white cue ball.

Pool games include pyramid, Chicago, forty-one, and American; but by far the most widely played is continuous pool. This requires 15 balls, numbered 1 to 15. They are arranged in the form of a triangle, the apex on the pyramid spot at one end of the table. The player opening the game drives the cue ball at the apex ball, thus scattering the triangle. Thereafter he must call his shots, i.e., declare his intention to drive a specific ball into a specific pocket. If he pockets the 8-ball, he is credited with 8, etc. He continues to play until he fails to pocket his ball, when it becomes his opponent's turn. If he inadvertently pockets the cue ball, he forfeits credit for any ball pocketed in that drive. Under certain regulations, if he pockets the cue ball and has not pocketed a numbered ball, he loses credit for his last previous score. Balls which are pocketed but not called by a player are replaced on the pyramid spot.

Consult Handbook of Standard Rules of Billiards and Pool.

POOLE, ERNEST (1880-), American writer, was born at Chicago, Ill., Jan. 23, 1880. He was educated at Princeton and traveled as a correspondent in France, Germany and Russia. In 1915 *The Harbor* was published, bringing wide recognition. Poole has written competently and sincerely. His novels include *His Family*, 1917, *His Second Wife*, *Millions*, 1922 and *Silent Storms*, 1927. He also wrote the plays, *None So Blind* and *A Man's Friends*.

POOLE, a municipal borough, county in itself and seaport of Dorsetshire, England, lying between Holes Bay and the inlet of Poole Harbor which extends 6 miles inland from a narrow entrance, about 113 mi. southwest of London. Of early settlement, Poole escaped mention until after Danish occupation, but by the 18th century it was a roaring port with a fleet of windjammers that sailed the seas wholeheartedly pirateering and smuggling. The early 18th century red brick houses, the town hall and harbor office among other buildings attest the town's prosperity and spirit in those times. To-day Poole's maritime activities are confined to a coastal traffic. Pop. 1921, 43,649; 1931, 57,258.

POOLS, in market parlance, combinations of persons for the purpose of increasing or depreciating the price of a certain stock or stocks. Pools are usually formed when the market is active, the participants in the joint venture agreeing to divide all losses or gains. Usually a manager is given power to conduct operations and the pool members agree not to trade in the security separately while the pool is in existence. Pools are given various names (see BLIND POOL) according to the nature of their agreements. Pools are not invariably successful.

POOP, the raised after part of a vessel above the weather deck corresponding to the FORECASTLE forward. It is often fitted with state rooms for petty officers, and with store rooms for rope and miscellaneous deck equipment.

POOR MAN'S WEATHERGLASS, one of the numerous names for the PIMPERNEL, the flowers of which close upon the approach of storms.

POOR RELIEF, a charitable practice of civilized societies from early historic times. In the Middle Ages almsgiving was a religious duty. Monasteries promoted vagrancy by indiscriminate relief. Punishment for vagrancy was tried in England until 1601 when the famous Poor Law of Elizabeth enacted a method of relief based upon hundreds of years of experimentation with the problem. Able-bodied poor were set to work and punished when they refused. Almshouses were provided for the helpless poor. Dependent children were apprenticed to a craft and in general, near of kin were held responsible to provide relief. Except for administrative modifications made to correct abuses, these principles have remained the foundation of the English poor relief system. The 19th century brought new and constructive principles.

In Germany was the Hamburg-Elberfeld system of central registration of public relief cases to prevent abuse, duplication and neglect, local supervision of relief giving by district visitors and constant effort to rehabilitate the poor; in England, the private Charity Organization Society, aimed to organize existing private and public relief agencies of the city to secure harmonious cooperation in relief, to restore the destitute to independence and to avoid the abuses of overlapping. The movement spread to America and in the 20th century these private societies became known as Family Welfare Associations. The emphasis is on investigation, diagnosis, treatment and follow up of each case. Cooperation with all other helpful agencies in the community and confidential central registration and clearance of all cases as a means of better understanding is a fundamental procedure.

Meanwhile the new methods of private relief spread to the older private relief societies and gradually to public poor departments. The more progressive states have established central supervision and control of private as well as public relief whether indoor, in poorhouses or hospitals, or outdoor, relief given in the homes of the poor. Although many poorhouses still exist the trend is to reduce the inmates of these to the destitute aged and to distribute to the more modern and specialized agencies of hospitals and custodial institutions, the feeble-minded, insane, epileptic, delinquent, crippled and all children. The latter are given relief in their own homes or placed in good foster homes rather than maintained in orphan asylums. Doles are still given by public relief departments in the form of small money payments especially during periods of depression and unemployment. But the emphasis even in public relief departments is upon making relief adequate as a means of tiding-over until restoration to self-support can be accomplished. In contemporary times these new principles of constructive outdoor relief which aim at rehabilitation have been applied by the Red Cross societies to restore those who suffer from famines, floods and disasters, and applied by state departments of

public welfare to widowed, deserted or poor mothers (called mothers' pensions or **MOTHERS' AID**) who have young children to rear. The aim is to preserve home life by adequate supplementary income in money payments. F. S. C.

BIBLIOGRAPHY.—E. T. Devine, *Principles of Relief*, 1904; A. G. Warner, *American Charities*, 1919, J. L. Gillen, *Poverty and Dependency*, 1921.

POOR RICHARD'S ALMANAC, a publication issued by BENJAMIN FRANKLIN between 1732 and 1757, under the assumed name of "Richard Saunders" or "Poor Richard." Containing homely proverbs, moral precepts and wise sayings, *The Almanac* was extremely popular among the colonists.

POORTEN-SCHWARZ, VAN DER. See MAARTENS, MAARTEN.

POOR-WILL (*Phalacroptilus nuttalli*), a small bird of nocturnal habits allied to the WHIPPOORWILL, so called in imitation of its peculiar, mournful notes. It frequents open prairies and barren arid regions in the western United States, wintering southward to Guatemala. The poor-will is 7 or 8 in. long with very soft velvety plumage, brownish gray, irregularly marked with black above, and barred blackish and light buffy below, with a large white patch on the throat. During the day it rests on the ground and at night seeks its insect food which it catches on the wing in its large, gaping, bristle-armed mouth. Its two pure white or lightly marked eggs are usually laid on the bare ground. Three varieties of the poor-will are recognized in the United States.

POPAYÁN, a town of Colombia, capital of the state of Cauca, situated at an elevation of 5,712 ft., 240 mi. southwest of Bogotá. It lies on a plateau between the volcanoes Puracé and Sotara, each rising to a height of 15,420 ft., with the volcano Pan de Azúcar, 16,000 ft. high, in the distance. The climate of Popayán is healthful. It has a university and other schools. The main industry is the manufacture of woolen blankets. It was established in the middle of the 16th century. Pop. 1928, 31,829.

POPE, ALEXANDER (1688-1744), English poet was born in London, May 21, 1688, the son of a linen-draper. His formal education was slight, as his Roman Catholic upbringing debarred him from the public schools, but so diligently and excessively did the poet study by himself that he early undermined his health. It was his boyhood ambition to translate Homer into English verse, and his intellectual projects and actual accomplishments were all similarly precocious. Pope made his bow as a man of letters at 17, when he contributed his "Pastorals" to Tonson's *Poetical Miscellany*. Two years later he published the notable *Essay on Criticism*, one of the most precocious productions in English literature. Yet its fame was eclipsed the following year by *THE RAPE OF THE LOCK*. For the next 12 years, beginning in 1713, Pope was mainly occupied with his translation of Homer, a labor in which he was greatly assisted by Elijah Fenton and William Broome. The first installment of the *ILIAD* was issued in 1715, the

last in 1720; the translation of the *Odyssey* was completed in 1725. Though often criticized, the translations continue to hold their own among subsequent, more literal versions. In 1725 Pope brought out an edition of Shakespeare. It was by no means flawless, and among those who scoffed at the ill-advised work was Lewis Theobald, a more proficient Shakespearean editor. Pope's next poem, *The Dunciad*, rained abuse and ridicule upon Theobald. The first book of the vitriolic poem appeared in 1728. In 1742 the republication of a fourth book of the poem evoked an abusive letter in the form of a pamphlet from COLLEY CIBBER to Pope, and straightway Pope recast *The Dunciad*, making Cibber the unenviable hero. After *The Dunciad*, Pope turned to more philosophic themes. His later works include *The Essay on Man*, published in four parts in 1732-34, *Moral Essays*, *Imitations of Horace* and a *Prologue to the Satires*, better known as the *Epistle to Dr. Arbuthnot*. The poet died at Twickenham, near London, May 30, 1744.

As a man Pope has been criticized for the injustice of his attacks on others, for his intrigues, his excessive love of fame and even for his monstrous personal appearance. Of the poet, however, it remains true that he influenced the 18th century perhaps more than any other poet has ever influenced his time. His wit, his uncanny epigrammatic compression, his mastery of the HEROIC COUPLET, formal, exact, clear as crystal—these qualities were imitated by nearly every poet of the 18th century. He was not indeed a poet of high spiritual significance, but to those who can admire the poetry of intellect, written with the utmost technical perfection, Pope will always be an idol. See also CLASSICISM; ENGLISH LITERATURE.

BIBLIOGRAPHY.—Sir Leslie Stephen, *Alexander Pope*, 1908; J. W. MacKail, *Pope*, 1919.

POPE, JOHN (1822-1892), American soldier, was born in Louisville, Ky., Mar. 16, 1822. After graduating from West Point in 1842, he served as officer in the Mexican War, and was brevetted for bravery in battle. Following this he went on exploring and engineering expeditions in the Southwest from 1853 to 1859 and was in charge of surveying the route of the Pacific Railroad. He was appointed captain in 1856. At the outbreak of the Civil War Pope became brigadier-general of volunteers, in command of Northern Missouri. He had spectacular successes in 1862 in the capture of New Madrid and Island No. 10 (Apr., 1862) and in the siege of Corinth. He was then appointed major-general of volunteers and given command of the Army of Virginia. This proved beyond his ability and after being badly beaten at the second battle of Bull Run, Aug. 29-30, 1862, he resigned. He redeemed his reputation by competent service against Indian uprisings in the Northwest. He then returned to service in Missouri in 1865, having command of this and other military districts until 1886, when he retired with the rank of major-general of the regular army, to which he had been promoted in 1882. Pope died in Sandusky, O., Sept. 23, 1892.

POPE, JOHN RUSSELL (1874-), American architect, was born in New York City, Apr. 24, 1874. After graduating from the School of Mines at Columbia University, he became a fellow of the American Academy in Rome in 1895, studied with a Schermerhorn traveling fellowship, 1896-97, and worked at the Ecole des Beaux Arts, Paris, in 1900; he opened a New York office in that year. He was architect of the Scottish Rite Temple, Washington; Terminal Station, Richmond; Baltimore Museum of Art; American Battle Monument, Montfaucon, France, and many other public buildings, as well as numerous private residences. He was elected to the French Legion of Honor in 1922.

POPE, an ecclesiastical term. In the Catholic Church, the term is reserved strictly for the supreme pontiff, and it is only in an opprobrious sense that sometimes the General of the Jesuit Order is spoken of as "the Black Pope." In the Greek Church any priest may be called a *papa*, pope, and generally speaking the word is applicable, by way of description, to a religious dignitary of high authority, e.g., Buddhist "pope."

POPLAR, the common name for a group of quick-growing trees with handsome foliage, many of which are valued for timber, pulpwood and ornamental planting. Botanically they belong to a numerous genus (*Populus*) of the willow family. There are about 35 species, natives of temperate and cold regions of the Northern Hemisphere, ranging from the arctic circle southward to Mexico in the New World and to north Africa, the southern Himalayas and Japan in the Old World. Fifteen native kinds, together with several introduced species and hybrids, are found in North America, widely distributed from the Atlantic to the Pacific.

Poplars are usually large to medium-sized trees with pale furrowed bark, soft white wood, resinous winter buds and long-stalked broad leaves. The small greenish flowers, which appear before the leaves in early spring, are borne in narrow pendulous clusters (aments), the male (staminate) and the female (pistillate) on different trees. The podlike fruits, ripening before the leaves are full grown, contain numerous small silky-tufted seeds, which, like those of the willow, are borne long distances by the wind.

Most poplars grow in moist or wet soil with a vigorous root system which penetrates to great depths to reach a permanent supply of water. In the United States and southern Canada poplars commonly occur singly or scattered in small groups in valleys and along stream banks. On cool mountain slopes and in the far North some species, as the aspen and tacamahac, form extensive forests. Throughout many prairie regions and also in deserts poplars form narrow fringes of trees along watercourses, often constituting with some of the larger willows, the only available fuel and construction timber.

The smaller poplars with slender-stalked tremulous leaves are commonly known as aspen or quaking asp, especially the Old World ASPEN (*P. tremula*)

and the American aspen (*P. tremuloides*), which, in high northern latitudes, practically encircle the globe.

In the United States the larger species of poplar are generally called COTTONWOOD, as the common or southern cottonwood (*P. balsamifera* var. *virginiana*), of the eastern and southern United States, sometimes 100 ft. high, and the black cottonwood (*P. trichocarpa*), found from California to Alaska, sometimes 200 ft. high, the most massive deciduous-leaved tree of the North American Pacific coast.

The balsam poplar or tacamahac (*P. Tacamahacca*) with highly fragrant buds, ranging from the northern United States to Labrador, Mackenzie and throughout the valley of the Yukon, is the largest sub-arctic American tree. It is the most common tree along the streams in the prairie region of the Canadian Northwest, often growing 100 ft. high in the valleys of the Peace and Athabasca rivers. The BALM OF GILEAD (*P. candicans*), extensively planted and naturalized in eastern North America, is regarded as a variety of or a hybrid derived from the balsam poplar.

Among other native American poplars are the swamp cottonwood (*P. heterophylla*), of the southeastern United States; the narrow-leaved cottonwood (*P. angustifolia*) and the lance-leaved cottonwood (*P. acuminata*), of the Rocky Mountain region, and the Fremont cottonwood (*P. Fremontii*), the Arizona cottonwood (*P. arizonica*) and the Mexican cottonwood (*R. Wislizenii*) of the southwestern states.

The white or silver-leaved poplar (*P. alba*), called also abele: the black poplar (*P. nigra*) and its well-known variety, the Lombardy poplar (var. *italica*), with numerous upright, very slender branches, all natives of the Old World, are extensively planted as ornamentals and are also more or less naturalized in the eastern United States and Canada. Many native poplars are likewise planted for shade and street trees and also for quick timber and fuel.

Although of inferior quality the wood of most native American poplars is devoted to various local uses and, where the supply is abundant, is extensively utilized for woodenware, interior finish and pulpwood. In 1930 the total cut of poplar lumber in the United States, mostly cottonwood and aspen, amounted to 158,410,000 bd. ft., valued at the mill at \$3,600,659, most of which was produced in the Mississippi valley. See also SUDDEN SAWLOG.

A. B. J.

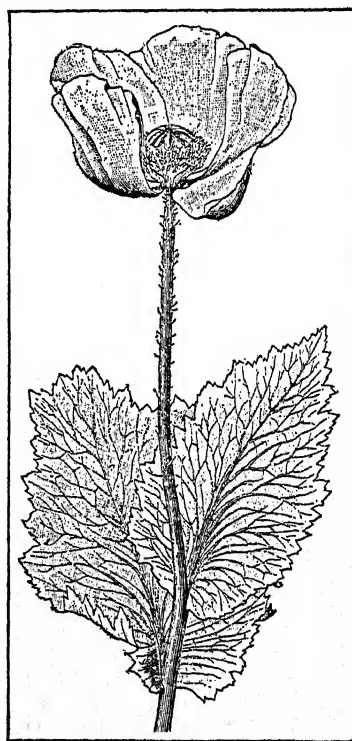
POPLAR BLUFF, a city in southeastern Missouri, the county seat of Butler Co., situated on the Black River, 160 mi. south of St. Louis. Two railroads and small river craft serve as transportation facilities for farm crop and lumber. The manufactures of Poplar Bluff include flour and lumber products. The city became the county seat in 1850, and was named for the grove of poplar trees growing on the site. The railroad was laid in 1873, and in 1892 Poplar Bluff was chartered as a city. Pop. 1920, 8,042; 1930, 7,551.

POPOCATEPETL, a dormant volcano of Mexico, situated 14 mi. south of Mexico City and nearly midway between the Atlantic and Pacific oceans. Its

name is an Aztec word meaning smoking mountain. The cone rises 17,540 ft. above the sea and rests with its western front on the Mexican plateau. Forests extend to 13,000 ft. and the summit is a distinct crater, elliptical in form, with a diameter not over 2,700 ft. and an unknown depth which is estimated at 1,657 ft. In the intense sunlight the ragged walls of the crater display a variety of colors of dazzling brightness.

The stratified condition of the cone indicates a long period of volcanic activity. Popocatepetl is known to have been active at the time of CORTÉS' conquest of Mexico, for Bernal Diaz told of the smoke and red-hot stones cast out by it, and it probably did not become dormant until the latter part of the 17th century. It was first ascended by Diego Ordaz in 1522 at the command of Cortés and again that year by Francisco Montano. Hans Gadow climbed it in 1904. The huge quantities of sulphur found within the crater are exploited commercially and equal the best obtained from Mt. Etna.

POPPY, a numerous genus (*Papaver*) of herbs of the poppy family comprising many favorite garden flowers. There are about 100 species, natives chiefly of the Old World, a few occurring in western North



COURTESY IOWA GEOL. SURV.

OPIUM POPPY

America. They are annual, biennial or perennial plants, with a milky juice, bearing lobed or deeply cut leaves and showy flowers produced singly on long stalks, the buds nodding. The fruit, an oblong or globular capsule, opens when ripe by pores near the top, shedding numerous very small seeds.

The best known species is the opium poppy (*P. somniferum*), a smooth annual, 2 to 4 ft. high, with large white, red or purple flowers, widely grown as the source of opium and in numerous varieties as an



GARDEN POPPY
(*Papaver orientale* var.)

ornamental. Other species extensively cultivated are the Iceland poppy (*P. nudicaule*), native to arctic regions, with fragrant white, yellow or reddish flowers; the tulip poppy (*P. glaucum*), native to western Asia, with large scarlet flowers; the oriental poppy (*P. orientale*), a robust perennial native to Mediterranean countries, bearing scarlet flowers 6 in. across, with a black base, and the corn poppy (*P. Rhæas*), a slender annual abundant in Old World grain fields, usually bearing red flowers, with numerous garden varieties including the popular Shirley poppies.

The name poppy is applied to many other plants of the poppy family as the CALIFORNIA POPPY, the Welsh poppy, and the sea poppy.

POPPY OIL, a vegetable oil, made by pressing the crushed seeds of the poppy, *Papaver somniferum*. The

the mixing of oil paints. Since it does not turn rancid as quickly as olive oil, the best qualities are often used as a salad oil, while the poorer qualities are utilized in varnish and soap-making. The residue of the cakes, after the oil has been pressed out, is sometimes squeezed into cakes.

W. J. L.

POPULAR SOVEREIGNTY, or Squatter Sovereignty, the doctrine loosely suggested by several statesmen in the 1840's and proclaimed clearly and succinctly by Lewis Cass in 1847 and afterwards, that any state constructed from the western territory be admitted with or without slavery, as the people of the projected state might decide. This theory as stressed by Senator STEPHEN A. DOUGLAS in the debates upon the Nebraska Bill and the KANSAS-NEBRASKA BILL, implied the repeal of the MISSOURI COMPROMISE, which prohibited slavery in any part of the LOUISIANA PURCHASE north of latitude 36° 30'. Under the COMPROMISE of 1850 Utah and New Mexico were organized as territories with the final determination of slavery left to the inhabitants when they should frame a state constitution. Douglas's proposal, designed to attract southern support, was an extension of this procedure to the territory which had been closed to slavery by the Missouri Compromise in 1820.

POPULATION, the whole number of inhabitants of a region. Few problems are of greater human significance than those inherent in the distribution of population and the relations between the different elements composing it. Census data permitting us to analyze these elements are now available on about two-thirds of the population of the world, a population estimated in 1926 as totaling 1,879,595,000. China and India together have approximately 800,000,000, making up about three-fourths of the population of Asia and about 44% of that of the entire world. Some idea of the unevenness with which population is distributed over the globe may be gained from the following data on the density of population per square mile on the different continents, based upon estimates for 1926 by the International Statistical Institute. In Europe it was 126.2, in Asia 60.6, in America 13.0, in Africa 12.4, and in Oceania (including Australia, New Zealand and the Pacific Islands together), 2.6. It must be born in mind in surveying these figures that 4,890,000 sq. mi. of Arctic and Antarctic land help to lower the average density of population. Even when only habitable land is considered, however, density can be seen to vary tremendously, for in the world as a whole about two-thirds of the population lives on about one-eighth of the habitable land, and just about half of the population of North and South America together lives in the United States. There are two kinds of densely populated areas: warm, damp, rice-producing regions like China and Japan, and industrial regions, usually with variable, stimulating temperate climates, like Belgium and New England.

In general, all over the world, more males than females are born. Males have a distinctly higher mortality, however, than females. The cases in which



COURTESY IOWA GEO. SURV.

GARDEN ORIENTAL POPPY
Papaver orientale

seeds themselves contain no opium, and when pressed 'cold,' at a temperature not exceeding 105° F., yield in almost colorless and odorless, transparent fluid of not unpleasant taste. The oil belongs to the group of linoleic or drying oils, and is much in demand for

adult males outnumber adult females are due either to immigration of males, as in the United States, or, as in India, to a neglect of girl children so pronounced as to outbalance the greater hardness of girls.

Of all the problems connected with population, the most interesting, undoubtedly, is that of the relation between the birth rate and the death rate. In all civilized countries the infantile death rate has markedly decreased during the last century. The birth rate in these countries, however, has also been steadily decreasing, but it has not declined so much as to decrease the total populations. In 1910-14 the excess of births over deaths per 1,000 of population was as follows in various European countries: Australia, 17.1, Austria, 10.5, Belgium, 7.6, Bulgaria, 18.6, Denmark, 13.5, France, 0.4, Germany, 12.5, Hungary, 12.8, Norway, 12.2, Rumania, 17.4, Spain, 8.9, Sweden, 9.8 and the United Kingdom, 10.0. In the most crowded countries, however, notably China and India, the rate of natural increase is considerably higher, and probably the most serious world problem of the future will be the checking of this increase as the available natural resources of the world diminish.

BIBLIOGRAPHY.—A. M. Carr-Saunders, *The Population Problem*, 1922, E. A. Ross, *Standing Room Only?*, 1927, F. Place, *Illustration and Proofs of the Principle of Population*, 1930; W. S. Thompson, *Population Problems*, 1930.

POPULATION OF UNITED STATES, CONTINENTAL. The total population of Continental United States on the census date, Apr. 1, 1930, was 122,775,046, an increase of 16.1% over the enumeration of Jan. 1, 1920. The elapsed time between the two censuses was 10 years and 3 months, compared with 9 years and 8½ months between the enumeration of 1910 and 1920. After making adjustment for this difference in time, the population increased 15.4% during the decade 1910-20 and at only a slightly faster rate, 15.7%, during 1920-30. These decennial increases fall far below that of the first ten years of the present century, 21.0%, or the still more rapid growth following the Civil War, 26.0% each decade. The World War, with its effect upon immigration and emigration, the influenza epidemic of 1918, and the declining BIRTH RATE had a marked influence on the growth of population. Of the 17,064,426 added to the population since the last census, natural increases, excess of births over deaths, contributed over four times as many individuals as did net immigration.

According to the 15th Census, Negroes constitute less than one-tenth (9.7%) of the total population, as compared with about one-fifth (19.3%), in 1790. The proportion is slightly less than in 1920 (9.9%), although they have increased more rapidly during 1920-30 than during 1910-20 (13.6% compared with 6.5%). This comparison exaggerates the recent increase because of the unequal periods between the two censuses. The increase is unevenly distributed over the country, 63.6% increase in the North, 5.0% in the South and 53.1% in the West. North includes New England, Middle Atlantic, East and West North

Central States. South includes South Atlantic, and East and West South Central States. West includes Mountain and Pacific States. The geographic distribution of the Negroes has changed greatly since 1900, when 89.7% lived in the South and only 10.0% in the North. In 1930 only 78.7% were found in the South, 20.3% in the North, and about 1% in the West. Migration to the North has proceeded rapidly during and since the World War.

For the first time the Mexican element in the population, by reason of its growing importance, both in numbers and distribution, was given a separate classification in the 15th Census. At prior censuses this element has been largely included with the white population. There were enumerated 1,422,533 persons of Mexican birth or parentage, which is more than double (203.1%), the estimated number in 1920. About 86% of the Mexicans still live in the Southwest, in Texas, California, Arizona and New Mexico, but it is noteworthy that considerable numbers have found their way into the industrial states, Illinois, Michigan and Indiana.

Urban and Rural. No differences in composition of populations are more fundamental in their influence on the lives and problems of the people than those arising out of urban or rural living. The growth of cities in the United States has been rapid

PROPORTION OF THE POPULATION OF CONTINENTAL UNITED STATES LIVING IN PLACES OF DIFFERENT SIZES AND IN RURAL AREAS

Size	1900 %	1910 %	1920 %	1930 %
100,000 and over	18.7	22.1	26.0	29.6
1,000,000 and over	(8.5)	(9.2)	(9.6)	(12.3)
25,000 to 100,000	7.3	8.9	9.8	10.5
2,500 to 25,000	14.0	14.8	15.6	16.1
TOTAL URBAN	40.0	45.8	51.4	56.2
Incorporated Places (Under 2,500)	8.3	8.9	8.5	7.4
Other Rural	51.7	45.3	40.1	36.4
	100.0	100.0	100.0	100.0

At the beginning of the century 40% of the population lived in places of 2,500 or over and 18.7% in cities of 100,000 or over. At the last enumeration 56.2% were found in urban centers and almost one-third (29.6%) of the total population in large cities of 100,000 or over. About one-eighth of the total population lived in cities of 1,000,000 or over.

However, the growth of cities during 1920-30 has been less certain than in former periods, 102 cities of over 10,000 lost population during that period. Furthermore, population growth has been especially rapid in suburban territory adjacent to cities of 100,000 or over, more rapid generally than in these cities proper. This differential is particularly large for cities of 250,000 to 1,000,000.

Increasing urbanization, 1920-30, is characteristic of all classes in the population, but the degree of urbanization varies in different color and nativity groups, being least among Negroes (43.7% urban) and great-

est among the foreign-born whites (80.3%). The native-born of native parentage group is 47.8% urban compared with 42.0% in 1920.

Age Composition. The proportions of young and old in the population of the United States are rapidly changing. While the total population increased 16.1% between the last two enumerations, the number of children under one year of age actually decreased by over 66,000. Children under five years of age formed only 9.3% of the total in 1930, a decline from 10.9% in 1920. Average length of life has greatly increased in recent decades, due to control over child mortality, contagious and infectious diseases and tuberculosis. The birth rate is declining rapidly, which lowers the proportion of young at the same time that health measures prolong lives. Immigration, which decade by decade contributed millions to the age group 20 to 45 years, has been greatly restricted.

A steadily increasing proportion of the total population is over 45 years of age, 22.8% in 1930 as compared with only 20.8% in 1920. The increasing proportion over 65 years of age (5.4% in 1930 compared with 4.7% in 1920) is directly related to problems of old age pensions and to dependency. However, the economically productive age group, 15 to 65 years, formed a larger proportion of the total population in 1930 (65.1%) than in 1920 (63.4%). As a result of the ageing of the population the death rate may be expected to rise gradually to meet the declining birth rate, in spite of scientific discoveries and health measures.

There are marked differences in the age composition of the urban and rural sections of the population. The percentage of children under five years of age is highest in the rural-farm population (11.1%) and lowest in the urban group (8.2%). This is due to the higher birth rate in rural areas and to the steady migration from the farms and from foreign countries to the cities, leaving a larger proportion of the young behind and swelling the vigorous middle-age groups of the urban industrial centers. The proportion under 15 years of age in the rural-farm population is 36.0%, as compared with 25.8% in the urban group. In contrast, the proportion 15 to 65 years of age in the farm population is only 58.7% as compared with 69.0% in this economically productive age period in the cities.

The contrast in age composition is even more striking between the native-born whites of native parentage and the foreign-born whites. The percentage of native whites of native parentage under 15 years of age is 33.9%, as compared with only 2.2% in the foreign-born white population. In contrast, 85.3% of the foreign-born are 15 to 65 years of age, compared with only 61.2% of the native-born of native parentage. In 1930, 12.4% of the foreign-born whites were 65 years of age and over, as compared with only 4.9% of the native-born.

Sex. The sex ratio is the number of males per 100 females, and this measure indicates the relative

numbers of the sexes. The proportions of the sexes influence marriage, birth and death rates and affect social and economic relations in the community. The sex ratio varies according to color and nativity classes, and with the geographic location and the urban or rural character of the population. For the total population it was 104.0 in 1920 and decreased to 102.5 in 1930. The trend for the whites has been toward equality of numbers between the sexes, except in certain eastern states in which westward migration of males has left an excess of females.

The urban group, in all classes of the population except the foreign-born, shows an excess of females (total urban 98.1, native whites 96.0, Negroes 91.3, foreign-born whites 111.0). The rural group, in contrast, has an excess of males in all classes (total rural 108.3, native whites 107.6, Negroes 101.7, foreign-born whites 134.0). The figures indicate a more rapid migration of females than of males to the city. This excess of females results in a larger proportion of females being unmarried in the city.

Nativity and Parentage of the White Population (exclusive of Mexicans). During 1920-30 the native born element of the white population, as a proportion of the total, increased (85.9% in 1920 to 87.7% in 1930), while the foreign-born element declined (14.1% in 1920 to 12.3% in 1930). The native-born of native parentage increased from 62.1% to 64.4% of the total white population. The decennial rate of increase of the native-born was 18.1%, as compared with 0.8% for the foreign-born. The native-born of native parentage increased at varying rates in all the states, from 2.5% in Vermont to 74.6% in California. The large increase of 37.7% in the Mountain and Pacific States represents migration from other parts of the country. In contrast, 39 of the 48 states show declines in their foreign-born populations, ranging from 1.6% to 80.0%. The only states with considerable increases were New York (New York City alone having an increase of 301,853), New Jersey, Michigan, and California.

Citizenship of the Foreign Born White Population. Of the foreign born white population in 1930, 58.8% had become naturalized citizens and 9.3% more had taken out their first papers, as compared with 48.7% and 9.2% respectively in 1920.

Marital Status. Populations differ as to the proportions, 15 years of age or over, classified as single, married, widowed or divorced. In 1890, 53.9% of the males, 15 years of age and over, were married and 56.8% of the females; in 1930 these proportions had increased to 60.0% and 61.1% respectively. At each census since 1890 the proportion married has shown an increase for both men and women. The proportions reported as divorced increased since 1920, from 0.6% for males and 0.8% for females to 1.1% and 1.3% respectively.

For both men and women the largest percentages married are found among the foreign-born (70.8% and 70.0% respectively), about 10% larger than for

the entire population, 15 years of age and over. In the Western states, where there is a marked excess of males, a smaller proportion of males is married (Pacific States, 57.2% of males and 62.3% of females married). In cities, where there is an excess of females, a smaller proportion of females is married (58.5% of females and 60.5% of males). As proportions of the sexes approach equality, the proportions married also tend to become the same. R. E. CH.

BIBLIOGRAPHY—Warren S. Thompson, *Population Problems*, 1930, Fifteenth Census, *Population Bulletins, First and Second Series*, Census Bureau, Washington.

POPULIST PARTY, the popular name for the People's Party, organized in 1891, which presented a national ticket in five elections, 1892-1908. It was a political extension of endeavors for the social and economic betterment of country people by the GRANGERS and the Farmers' Alliance. Its platform demanded free, unlimited coinage at SIXTEEN TO ONE; a national currency, flexible, and a full legal tender; a graduated income tax; government ownership of railroads; postal savings banks; popular election of United States senators; the adoption of the initiative and referendum, and other democratic reforms. In 1892 its candidate for the presidency, James B. Weaver, received 1,055,424 votes; the party carried four state legislatures, Colorado, Idaho, Kansas and Nevada, and elected five United States senators. In 1896 the Populists nominated William Jennings Bryan, already the Democratic candidate, but presented its own candidate for vice-president. Those who, wishing to preserve the independence of the party, voted the straight Populist ticket were called Middle of the Roaders. In 1900 the party reluctantly nominated both Democratic candidates when its original nominee for vice-president withdrew. From its submergence of identity in this election the party never recovered. After polling an insignificant 29,000 votes in 1908, it ceased to exist.

PORBEAGLE, called also salmon shark, a large, swift-swimming SHARK (*Lamna nasus*) of great strength and voracity, attaining a length of 10 ft. It is found widely in northern seas, and is exceedingly destructive to salmon and other food fishes, especially on the coast of Alaska.

PORCELAIN, a fine type of pottery. It may be of any color, usually white or light cream; decorated or undecorated. The word porcelain is derived from the shell called in French *porcelaine* or in Spanish *porcelana*. There are two broad groups. The first, called hard porcelain, includes the decorated, natural kaolinic porcelains of the Chinese, a type later produced in Europe, and the various industrial porcelains, such as high tension insulators, chemical porcelain and sanitary products. All of these require a temperature of at least 2375° F. to reach practical maturity. They are essentially composed of clay-substance feldspar, some quartz and, in some cases, small quantities of alkaline earths, according to the special physical requirements which the product must meet. The second group, known as soft porcelain, embraces a series of types, all

possessing the essential requirement of translucency. This property may be obtained through several fluxing agencies, the use of calcined bone ash as in bone china, or the introduction of glassy melts, called frits, which cause these porcelains to vitrify or mature at lower temperatures than those required for the first group. However, there are rather wide gradations in both groups.

The glazes applied to hard porcelain often are harder and less fusible than those used on the soft porcelains, but not essentially so, as the American vitreous tableware carries a softer glaze than the hard fire porcelain of continental Europe.

Hard porcelain was made in China during the Han dynasty between the years 206 and 220 A.D., and was produced for more than 1500 years before the technique became familiar to European potters. Though little progress was made for 500 years, the development from the Sung to the K'ang Hsi dynasties, 420 to 1722, represents an almost continuous production of decorative porcelains which have influenced all other pottery-making countries.

In the United States, although comparatively little porcelain is made identical to the hard porcelain of continental Europe, a silicious type has been developed which is fired to approximately 2450° F. and to which a boro-silicate glaze is applied at a lower temperature. This procedure differs from the European, in which the glaze is matured simultaneously with the body at 2540° F. The American type of hard porcelain is being made at Syracuse, N.Y., Trenton, N.J., New Castle, Pa., Wheeling, W.Va., and other places. The decorative hard porcelains of Adelaide Alsop Robineau rank with the works of the great ceramic artists of other countries. In the group of the American soft porcelains, Lenox china is comparable in quality to the best of the English china wares.

F. H. R.

PORCELAIN ENAMELED PRODUCTS, articles fashioned from metal, having opaque glass surfaces. PORCELAIN enamel differs from lacquer and varnish products, sometimes called enamels. Ancient craftsmen applied enamels to gold, silver, and copper decoratively about 1400 B.C. The enamel was held by depressions in the metal surface. Thus originated modern porcelain enameling, which combines beauty, resistance to wear and corrosion, smoothness, easy cleaning and sanitation.

The transition to practical purposes occurred during the 19th century. Since 1910 the variety of porcelain enameled products has expanded greatly. Refrigerators, washers, bath tubs and kitchen stoves are representative articles. Porcelain enameling is confined to products made from cast iron or sheet iron, e.g., cast iron bath tubs and sheet iron refrigerator lining. Auto nameplates typify decorative enameled products on copper.

The surface of the metal object is cleaned either by blasting or chemicals, to remove oils and scale. Then either of the two common enameling processes are employed—the dry process for large cast products and

the wet process for sheet iron and small cast products. The steps of the dry process are: applying the wet base coat, drying, firing, withdrawing from the furnace, applying the dry coat by dusting it on the red-hot article, reheating until the surface is smooth and applying additional coats if necessary. The steps of the wet process are: applying the wet base coat, drying, firing, cooling and a similar sequence with one or more wet cover coats. Base coats mature at higher temperatures and are more refractory than cover coats. They form a bond between the metal and the enamel and insure adherence.

Dry-coat enamel is made by smelting glass-forming ingredients, per specific formulae, at about 2000° F. It is chemically composed of complex boro-silicate, and is made an opaque white by the addition of tin or antimony oxide and opacifying aids such as fluorspar, cryolite, and feldspar in the smelt. The wet coat consists of a water suspension of frit, stock clay, an opacifier, and an ELECTROLYTE. These are intimately ground, applied to the cold object by spraying, dipping or swilling, are dried and fired. Frit for a sheet-iron base coat has oxides of cobalt, nickel or manganese smelted into it to provide closer adherence. Sheet-iron cover frit is made clear or partially opaque. Its composition is such that the desired opacity results from the action of tin or zirconium oxide ground with the frit.

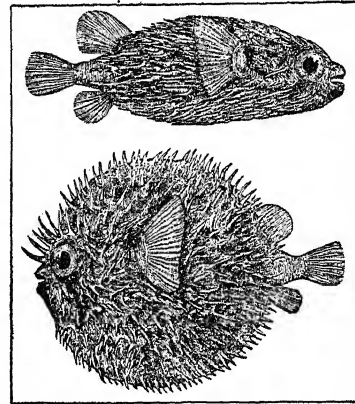
The more resistant and refractory the enamel, the higher must be the smelting and firing temperatures. The firing range is 1100 to 1750° F., depending upon the enamel and the tendency of the metal to warp. Firing furnaces are muffle or semi-muffle; intermittent or continuous in operation. (See KILNS.) The coefficient of expansion of the base metal and the enamel must be in satisfactory agreement in order to minimize the disruption of the enamel coating during manufacture and practical use. E. So.

PORCUPINE (*Erethizon dorsatum*), the largest arboreal North American rodent, found in the northern United States and Canada. There is an allied species in the northwest, and others occur in South America. The Old World porcupines belong to an entirely different group of mammals.

The back and tail of the porcupine are armored with quills, mixed with long, soft hairs. Contrary to popular belief, the animal cannot "shoot" its quills, though they come away at a touch and, being barbed like fishhooks, cannot easily be loosened once they are embedded. Many animals, including bear, deer and dogs, have died after getting a face full of quills. The porcupine browses on the bark of trees, including evergreens. For this reason, several states offer bounties for their extermination. Since the flesh is edible, some Canadian provinces protect the porcupine as the only animal that a lost and weaponless man can kill.

PORCUPINE FISH, the common name for a family (*Diodontidae*) of remarkable fishes allied to the swellfishes, found widely in warm seas. They have squarish or roundish bodies armed with sharp spines,

the bases of which form a continuous coat of mail, and fused jaw teeth forming an undivided beak. When disturbed, they inflate themselves with water or air and in the latter case float on the surface. All porcupine fishes are said to be poisonous, especially



PORCUPINE FISH
Normal (above) and inflated (below)

those occurring in equatorial waters. The common porcupine fish (*Diodon hystrix*), a sluggish fish 2 or 3 ft. in length, found in all tropical seas, is olive colored spotted with black and possesses very long spines capable of inflicting painful wounds. The closely allied lesser porcupine fish (*D. holacanthus*) is likewise widely distributed. The common rabbit fish or spiny boxfish (*Chilomycterus schoepfi*) of the Atlantic coast has a box-shaped body, sometimes 10 in. long, light green in color with black lines, and armed with triangular spines. See also SWELLFISH.

PORCUPINE GRASS (*Stipa spartea*), a perennial grass of striking appearance useful for hay and forage, called also devil's darning needles. It is found in prairies from Michigan to British Columbia and southward to Kansas. The smooth erect stem, 2 to 4 ft. tall, bears narrow leaves ending in a long slender point and a conspicuous flowering panicle. The narrow fruiting scale (lemma), enclosing the grain, tapers below into a very sharp hairy point, which acts as a barb, and terminates above in a stout awn 6 in. long, a portion of which becomes tightly twisted. Variations in moisture cause the awn to twist and untwist enabling the barbed grain to penetrate the soil.

PORFIRIUS, PUBLILIUS OPTATIANUS, a Latin poet of the 4th century, was perhaps a native of Africa. About the year 325 he composed a flattering panegyric on Constantine the Great, which pleased the emperor so much that he permitted the poet, who had been banished from Rome, to return to that city. It is thought that Porfirius may have been later raised to the office of prefect. His extant writings comprise 28 short poems, 20 of which were included in the panegyric addressed to Constantine. The poems are constructed in a highly artificial manner. A number of them take the form of a square, others form different objects such as an organ, an altar and the like.

PORGY (*Stenotomus chrysops*), a small, spiny-rayed, marine fish of the eastern coast of the United States, called also scuppaug, scup and fairmaid, highly esteemed as a pan fish. It has a deep, much compressed body elevated on the back, a small mouth armed with strong teeth, a deeply concave tail fin, and hard, firm scales; it is usually about a foot long, and 1½ to 2 lbs. in weight. In color it is brown tinged with reddish above and silvery below, the young having distinct cross bars. The porgy ranges from Maine to South Carolina but is abundant only from Cape Cod to Virginia. It swims usually in schools and feeds on the bottom, subsisting chiefly upon crustaceans, worms, mollusks, small fish and vegetable matter. From Rhode Island to New Jersey the porgy is an important food fish; in 1929 the total catch in United States waters was 12,305,000 lbs. valued at \$401,000. See ANGLING.

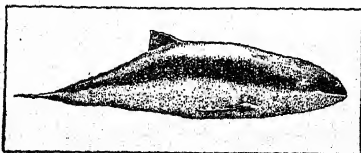
PORK, hog meat used as food. The hog carcass is split into two sides from which the following cuts are made: the shoulder, sometimes divided into "California picnic hams" and shoulder or Boston butt, the ribs, loin, hind legs or hams, bacon strip, fat back, pigs' feet and head. Because it contains more fat than beef and mutton, pork has a greater energy value, but also requires a little longer time in the stomach and is generally considered harder to digest. It is, however, as completely digested as other meats by most people.

BIBLIOGRAPHY.—H. C. Sherman, *Food Products*, 1924; W. H. Tomhave, *Meats and Meat Products*, 1925.

PORK PARASITES. See PARASITIC DISEASES.

PORPHYRY, a general term applied to IGNEOUS Rocks of a certain structure, irrespective of their mineral composition. The component minerals show two distinct sizes of crystals, more or less sharply divided. The larger ones, the phenocrysts, are scattered through a ground mass of finer crystallization. This ground mass may be dense and cryptocrystalline, to coarsely crystalline. It was formerly thought that this structure indicated two stages of cooling of the molten material, but it is now known that porphyritic structure can be produced in one stage of continuous cooling. Porphyries are known by the rock name appropriate for the ground mass, as granite porphyry. Porphyries are sometimes used for statuary and decoration. See also PETROLOGY.

PORPOISE, the name given to various small marine mammals of the DOLPHIN family. The common round-headed black porpoise or bottlenose (*Phocoena phocoena*) of American and European



COMMON PORPOISE

coasts and harbors, occurs throughout the North Atlantic and also in the Pacific. It is familiar to voyagers by its habit of accompanying vessels for miles

at a time, gamboling just before the ship's prow, apparently in joyous play. A somewhat larger species, 8 ft. long, is often seen. Other species are more localized, one of which, only 4 ft. long, abounds in the Orient. These animals go about in small schools, feeding on surface fishes, and frequently ascend rivers. In former times porpoises were esteemed in Europe as food, but the flesh is now rarely eaten; yet they are captured largely by the people of northern coasts for the sake of their oil and hides, the skin being useful for leather. E. I.

PORRO PRISMO. See PRISM, OPTICAL.

PORTAGE, a city in southern Wisconsin, the county seat of Columbia Co., situated on the Wisconsin River and the Portage Ship Canal, 30 mi. north of Madison. Airplanes, river craft and two railroads serve the city, which is a shipping market for grain, tobacco, poultry and other natural and locally manufactured products. The first white man, Laurence Barth, settled here as early as 1793. The canal was finished in 1856. Portage is the home of the author, Zona Gale. Pop. 1920, 5,582; 1930, 6,308.

PORTAGE LA PRAIRIE, the chief town of Portage la Prairie Co., Manitoba, Canada, situated 50 mi. west of Winnipeg, on the Assiniboine River, at the southern extremity of a portage from Lake Manitoba. Surrounded by a rich agricultural community, it has large grain elevators, flour mills, and a considerable export of farm produce. There also are small manufactures. A collegiate institute, an Indian training school, the provincial government buildings are situated here. Pop. 1921, 6,766; 1931, 6,597.

PORTALES, DIEGO (1793-1837), Chilean statesman, was born in Santiago of a distinguished family. His education was unorganized and sketchy. His first connection with politics was in 1824 as manager of Portales, Cea & Co., which was intrusted with the administration of the tobacco monopoly. He joined the conservatives in 1828 and participated in the revolution of 1829; from then on he was to play a decisive part in Chilean life and politics. In 1830-31 as minister of war and the interior he introduced a civil dictatorship. Portales was a realist, practical business man and a shrewd politician. He reorganized the armed forces, excluded the Liberal opposition from all places in the Government, and doubtless had some influence in the formation of the conservative Constitution of 1833. In 1835 Portales was called into the Cabinet again to constitute a second dictatorship, and in the following year he forced a war on the Peruvian-Bolivian Confederation, which he regarded as a menace to Chile. The war was not popular and on June 6, 1837 he was murdered by mutinous soldiers.

PORTAL VEIN, the large vein collecting blood from the capillaries of the digestive canal, pancreas, spleen, and gall-bladder and discharging it through a second system of capillary-like passages, the sinusoids, in the LIVER. Because its blood is in direct contact with the tissues at either end of its branching system, it is unique among veins. Foodstuffs absorbed by the intestine are to some degree taken up by the liver and

stored until needed. It is for this reason that the liver is interposed in the circuit of blood returning to the heart from the digestive tract. For position and tributaries see figure under VEINS.

PORT ANGELES, a port city in northwestern Washington, the county seat of Clallam Co., situated on the Strait of Juan de Fuca, 17 mi. from Victoria, Brit. Col., Canada, 85 mi. northwest of Seattle. Steamers, ferries, bus lines and two freight railroads serve the city. There is an airport. The harbor is free from all obstructions; its traffic in 1929, excluding general ferry traffic, amounted to 723,317 tons, worth \$15,073,600. The chief local manufactures are lumber products, pulp, paper and paper products. In 1929 the retail trade reached \$6,533,805. Manganees is mined extensively in the vicinity. The city is a market for dairy products, berries and poultry. Situated on the beautiful Olympic Peninsula, Port Angeles is a delightful tourist resort. The city was laid out by the United States Government in 1862 and was incorporated in 1890. Pop. 1920, 5,351; 1930, 10,188.

PORT ARTHUR (formerly Prince Arthur's Landing), a city and port in the Thunder Bay District, Ontario, Canada, situated on Thunder Bay. It is located at the head of navigation on Lake Superior, about 570 mi. northwest of Toronto, and 179 mi. northeast of Duluth, Minn. Known as a "Twin City" of Fort William, 4 mi. to the northeast, it handles most of the commerce of Lake Superior's northwest shore and is a point of transfer between lake steamers and the Canadian National and Canadian Pacific railways. The city has a heavy export traffic, largely in grain of the region, and in lumber which affords the chief local industry. Power derived from the Nipigon river supplies pulp, paper and planing mills, foundries, boiler works and important shipbuilding yards. Port Arthur is substantially built and owns its own public utilities. Pop. 1921, 14,886; 1931, 19,818.

PORT ARTHUR, a seaport at the tip of the Liao-tung peninsula, Manchuria. It has an ice-free harbor the year around. The port was fortified and made the chief naval station of China in 1891. It was taken in 1894 by the Japanese, who destroyed the fortifications. Japan was obliged to restore it to China, who leased it to Russia in 1898. It was again fortified and became a great naval station, and the chief terminus of the Trans-Siberian Railway. As a result of war with Russia it was captured by the Japanese in 1905. In 1915, the Chinese extended the lease to Japan for a period of 99 years. Pop. 1922, 22,649.

PORT ARTHUR, a city and seaport in Jefferson Co., southeastern Texas. It is situated on the west shore of Lake Sabine, at the head of the Port Arthur Ship Canal, about 15 mi. from the Gulf of Mexico. Bus and steamship lines and two railroads serve the city. The Texas Oil Company has a landing field for airplanes. Port Arthur is located in a fine oil region and owes its prosperity to the petroleum produced in the vicinity and to the oil refining industry. In 1929

the value of the local manufactures was about \$2,000,000; the retail trade amounted to \$21,635,071. Truck garden produce is the principal crop of the countryside. The city has completed a sea wall at the cost of \$2,000,000. Port Arthur was founded in 1898. Pop. 1920, 22,251; 1930, 50,902.

PORT AU PRINCE, the capital and most important city of Haiti. Located on the western coast of the island it has an excellent harbor sheltered by Gonaive Island; it serves as a seaport for West Indian trade. Two railroad lines and highways tie the city with the interior and several steamship lines connect it with New York. The principal exports are coffee, raw cotton and logwood. Port au Prince is in a sugar-growing district and an extensive sugar central has been constructed near the city. The University of Haiti is located here. Pop. 1929, 79,797, mostly Negroes.

PORT CHESTER, a village and port of Westchester Co., New York, situated on Long Island Sound, at the mouth of the Byram River, 26 mi. northeast of New York City. It is served by the New Haven Railroad, bus lines and freight steamers. Port Chester is a residential suburb and a trading and industrial center. Its manufactures include bolts and nuts, wire, boilers, radio appliances, blowers, pumps, stoves, clothing, linens, mattresses, castings, candy, machines, toys and carbonated beverages. In 1929 the total factory output was approximately \$12,000,000; the retail trade amounted to \$17,292,060. Harbor commerce, 1929, was 450,444 tons, valued at \$10,798,993. Port Chester was settled in 1637, but was known until 1837 as Saw Pit; it was incorporated in 1868. The village was the scene of Revolutionary maneuvers. Pop. 1920, 16,573; 1930, 22,662.

PORTE, THE SUBLIME. See OTTOMAN EMPIRE.

PORTER, DAVID DIXON (1813-1891), American naval officer, son of Commodore David Porter, was born in Chester, Pa., June 8, 1813. When his father resigned from the U.S. Navy in 1829, he entered the Mexican navy with him, but was soon after captured by a Spanish frigate. Soon afterward released, young Porter became midshipman in the U.S. Navy. He served with great distinction in the Civil War. In Apr., 1861, as lieutenant commanding the *Powhatan*, he went to the relief of Fort Pickens at Pensacola, and was promoted to commander. The following year he recommended a siege of New Orleans with Farragut in command. The expedition moved against that city in Apr., 1862, with Porter commanding the motor vessels. A terrific bombardment by Porter silenced the fortifications at the entrance of the Mississippi and opened the way for Farragut to gain New Orleans. In a similar way, he assisted Farragut to pass Vicksburg (June 28). In Sept., 1862, as acting rear-admiral, in command of the Mississippi squadron, he built for himself a formidable flotilla of vessels, assisting the army in the capture of forts along the Mississippi, including Arkansas Post (Jan., 1863), and aided in the capture of Vicksburg by General Grant on July 4, 1863, for which exploit

he was made rear-admiral. In 1864 he supported General Banks on the Red River, after the failure of which expedition he was shifted to the North Atlantic squadron and assisted in the taking of Fort Fisher, near Wilmington, in Jan., 1865. Following the war, he was superintendent of the U.S. Naval Academy, 1865-69, being made vice-admiral in 1866 and admiral in 1870. He died at Washington, Feb. 13, 1891.

PORTER, GENE STRATTON (1868-1924), American naturalist and writer, was born in Wabash Co., Ind., in 1868. She served on the staffs of various outdoor magazines as a natural history photographer before the publication of her first book, *The Song of the Cardinal*, 1902. *Fieckles*, her most popular novel, appeared in 1904. *A Girl of the Lumberlost*, 1909, *The Harvester*, *Laddie*, 1913, *At the Foot of the Rainbow* and others followed. Her books on natural history subjects include *Birds of the Bible* and *Friends in Feathers*. Mrs. Porter died in Los Angeles, Cal., Dec. 6, 1924.

PORTER, JANE (1776-1850), British novelist, was born at Durham, in 1776. Her sister, Anna Maria, was also a novelist. As a girl in Edinburgh her development was influenced by association with Flora MacDonald and young Walter Scott. In 1803 she published *Thaddeus of Warsaw*, which proved a great success, as did also *The Scottish Chiefs*, seven years later. The author died at Bristol, May 24, 1850.

PORTER, WILLIAM SYDNEY (1862-1910), American short story writer, whose pen name was "O. Henry," was born in Greensboro, N.C., Sept. 11, 1862. He received his only formal education at a school maintained by his aunt. As a boy he thrilled to the "dime novels" of the day. He worked for five years in the local drugstore, and at 20 went to Texas to work as a cowboy for two years; at Austin, Tex., he worked another four years in the General Land Office. He married Athol Estes, after a romantic elopement, and from 1894-95 served as teller in the First National Bank of Austin. He next ventured to publish a humorous paper, *The Rolling Stone*, but unsuccessfully. Porter was working on the *Houston Daily Post* when a warrant was issued for his arrest, charging him with having embezzled funds from the bank in Austin. He fled to New Orleans, then to Central and South America. In 1897 he returned to Austin, and to his wife's deathbed, surrendering himself to the law. He was sentenced, whether actually innocent or guilty, to the Ohio State Penitentiary for five years. He worked as night drug clerk in the prison dispensary, writing several short stories meanwhile, and was released for good behavior in 1901.

Porter resided thereafter in New York City, living obscurely and writing under various pseudonyms, the best known of which is "O. Henry." He began to publish his immensely successful stories in book form in 1904. The first volume, *Cabbages and Kings*, was followed by *The Four Million*, 1906, *The Trimmed Lamp*, 1907, *Heart of the West*, 1907, *The Voice of the City*, 1908, *The Gentle Grafter*, 1908, *Roads of*

Destiny, 1909, *Options*, 1909, *Strictly Business*, 1910, *Whirligigs*, 1910, and two posthumous collections, *Sixes and Sevens*, 1911, and *Rolling Stones*, 1912. From the first he showed himself a master of the short story. He had an appealing sense of humor; his style was easy, familiar yet technically compact; and his "surprise endings," in which the denouement comes in the last sentence or the last word, have been imitated since his day by innumerable short story writers. Porter died in New York City, June 5, 1910. See also **SHORT STORY**.

BIBLIOGRAPHY—C. A. Smith, *O. Henry*, 1916, Robert H. Davis, *The Caliph of Bagdad*, 1931.

PORTERVILLE, a city in Tulare Co., southern California, on the Tule River, 72 mi. southeast of Fresno, served by buses and the Southern Pacific and Santa Fe railroads. There is an airport. The city lies in a rich citrus and deciduous fruit growing region. Considerable cotton is also grown. Oil is found in the vicinity. Porterville is the seat of a junior college. California Hot Springs and Camp Nelson, popular summer resorts, are 35 mi. east. About 65 mi. northeast is Sequoia National Park, possessing the largest redwood trees in the world. Porterville, founded in 1888, was incorporated in 1902. Pop. 1920, 4,097; 1930, 5,303.

PORT HUDSON, SIEGE OF, May 27-July 8, 1863, an engagement of the Civil War resulting in a Federal triumph. Port Hudson, the Confederate fortress on the Mississippi, 200 miles below Vicksburg, was invested on May 22, 1863, by a Federal force under Gen. Banks. On the 27th Banks attempted to carry the fortifications by storm, but was repulsed with a loss of almost 2,000 men. Another assault, on June 14, was unsuccessful, despite the co-operation of Admiral Farragut with 15 vessels which simultaneously bombarded the fort. When Gen. Gardner, commanding the garrison of 6,000, learned of the surrender of Vicksburg (see **VICKSBURG, SIEGE OF**), Port Hudson was unconditionally surrendered. The Confederacy thereby lost 6,000 men, 51 cannon, 5,000 guns, and other supplies.

PORT HURON, a city of eastern Michigan, the county seat of St. Clair Co., situated as a port of entry on Lake Huron and the St. Clair River, about 56 mi. northeast of Detroit. Transportation is provided by two railroads, bus lines and daily steamers to Detroit. The city has foundries and car shops, and manufactures brass, paper and chicory. In 1929 the factory output was worth \$16,222,669. The retail trade in 1929 amounted to \$20,956,408. Several miles of beaches along Lake Huron form a popular summer resort region. Port Huron was incorporated as a village in 1849 and as a city in 1857. Pop. 1920, 25,944; 1930, 31,361.

PORTIA, the heroine of Shakespeare's *MERCHANT OF VENICE*. She loves Bassanio, but as a wealthy heiress has many suitors. All who would win her hand must choose among three small caskets, one of gold, one of silver, and one of lead. The lead casket containing Portia's picture is chosen by Bass-

anio, who then becomes her husband. In the famous trial scene Portia appears disguised as a lawyer and saves Antonio from the malice of Shylock.

PORTIÈRE, a curtain, usually of a heavy fabric, hung at the entrance of a room. To-day the portière is little used except to complete a carefully worked-out decorative scheme. It is a product of the late Victorian period, when every available space in a room was draped, including the mantel. Portières, sometimes hung in double pairs, usually matched the draperies at the windows or the upholstery of the furniture. Velvet, plush, brocade and even strands of beads were popular materials at the beginning of the 20th century.

PORT JERVIS, a city in Orange Co., southeastern New York, situated on the Delaware River at the mouth of the Neversink River, at the meeting point of New York, New Jersey and Pennsylvania, 70 mi. northwest of New York City. Two railroads serve the city. The Mongaup Falls generate hydroelectric power for the factories, which produce chiefly silk, glass, underclothes and silver-plate ware. There are large railroad shops. The manufactured output, 1929, was valued at \$6,642,336. The retail business in 1929 amounted to \$7,730,318. Port Jervis was named for John Bloomfield Jervis, the builder of the Delaware and Hudson Canal, now in disuse. The village was incorporated in 1853; the city in 1907. Pop. 1920, 10,171; 1930, 10,243.

PORTLAND, WILLIAM BENTINCK, 1st Earl of (c. 1645-1709), English statesman and soldier, son of Henry Bentinck of Diepenheim, was born in 1645 or 1649. He became an officer in the household of the Protestant William, Prince of Orange, and in 1688 sailed to England as a member of the prince's expedition of invasion. He remained in England when William and Mary became joint sovereigns after the abdication of the Catholic James II. In 1689 Bentinck was made earl of Portland. He was present at the siege of Namur and in 1697 he negotiated the Peace of Ryswick. The earl died at Bulstrode in Buckinghamshire on Nov. 23, 1709.

PORTLAND, WILLIAM HENRY CAVENDISH BENTINCK, 3rd Duke of (1738-1809), British statesman, was born on Apr. 14, 1738, son of William, second Duke of Portland. He was lord chamberlain in 1765-66, and in 1782 was appointed lord-lieutenant of Ireland. He was Prime Minister of a coalition government for eight months in 1783, Secretary of State in 1794-1801, and again Prime Minister from 1807 to 1809. He died on Oct. 30, 1809.

PORTLAND, a city in eastern Indiana, the county seat of Jay Co., situated on the Salamonina River. It is served by the Nickel Plate and the Pennsylvania railroads. Portland has mills and factories producing lumber, flour, automobile accessories, brooms, tiles and clothing. Gas and oil are found near by. The region is good farm land. Pop. 1920, 5,958; 1930, 5,276.

PORTLAND, the largest city of Maine, and the county seat of Cumberland Co., situated on Casco

Bay, on the Atlantic Ocean, about 108 mi. northeast of Boston. Its transportation facilities include the Boston and Maine, the Maine Central and the Grand Trunk railroads, steamship lines to coast ports and, during the winter season, to transatlantic points, bus lines, ferries and an airport. Portland has extensive shipping and fishing interests. The city has one of the finest harbors of North America, which is defended by six forts. The chief local manufactures are bakery products, canned goods and ice cream. The industrial output, 1929, was worth \$28,267,721. In 1929 the retail business amounted to \$56,077,186. The city occupies a hilly peninsula about 3 mi. long and $\frac{3}{4}$ -mi. wide, varying in elevation from sea level to 175 ft. The streets are well-paved, clean, and so abundantly supplied with shade trees in the residential district that Portland is sometimes called the Forest City. The surrounding region is noted for picturesque scenery, and this, combined with a delightful summer climate, makes the city a favorite vacation resort. Portland was the birthplace and for many years the home of Henry W. Longfellow, who has described the surrounding country in several poems.

The first permanent settlement was made here in 1633. The town suffered severely during the Indian wars. In 1775 it was attacked and burned by a British fleet. Portland Harbor was the scene of the battle between the *Enterprise* and *Boxer* in the War of 1812. From 1820 to 1832 Portland was the state capital; in 1832 it was chartered as a city. Pop. 1920, 69,272; 1930, 70,810.

PORTLAND, the chief city of Oregon, a port of entry and the county seat of Multnomah Co., situated in the northwestern part of the state on the Willamette River, near its junction with the Columbia. It is 108 mi. from the Pacific ocean, 50 mi. northeast of Salem, and is the industrial and financial center of the Columbia River basin. Transportation facilities include four transcontinental railroads, interurban bus and truck lines, an airport and over 60 steamship lines plying to all the principal ports of the world.

The city rises in terraces from both sides of the Willamette River. The upper residential sections command fine views of the river valley and the snow-clad summits of Mt. Hood, St. Helen's and other peaks of the Cascade Range. It has an extensive park system and picturesque highways. The climate is mild and equable and the death rate and infant mortality extremely low.

Portland has a fine fresh-water harbor, accommodating the largest seagoing ships, and excellent port facilities. It is a primary market for lumber, salmon, grain and flour. Fruit canning and meat-packing are also important. It is an active wholesale distributing center, with 443 organizations selling \$198,638,537 worth of merchandise in 1929; its 5,182 retail stores, which did an aggregate business of \$211,750,272 the same year, gave full-time employment to 19,309 people. Oregon's manufacturing industries have centered about Portland, due to its ample and inexpensive sup-

ply of water power. In 1929 the city's manufactures, which had a value of about \$172,000,000, included a wide variety of lumber and lumber products as well as logging equipment, furnaces, structural steel, leather and rubber products.

Settlers from New England founded the city in 1845, naming it after Portland, Me. It was chartered as a city in 1851. Since 1913 the city has operated under a commission form of government. Portland is the seat of Reed College, the University of Oregon Medical School, Benson Polytechnic School and other educational institutions. Pop. 1920, 258,288; 1930, 301,815.

PORTLAND CEMENT. See CEMENT.

PORT LOUIS, chief port and capital of the British island Mauritius, in the Indian Ocean. It is situated at the head of a bay on the northwest coast and is the terminus of the railway of the island. The city is the see of Roman Catholic and Anglican bishops and has besides the two cathedrals important observatories, mission schools and military barracks. Both harbor and city are strongly fortified. Pop., 1929, 54,147 including suburbs. See MAURITIUS.

PORTO. See OPORTO.

PORTO ALEGRE, the most important city in the far south of Brazil, the capital of the state of Rio Grande do Sul. It is situated in a productive area on the Guahyba River, about 159 mi. from the port of Rio Grande at the entrance to the lagoon. Several navigable streams entering the Logôa near the city give Porto Alegre considerable commercial importance, although large ocean steamers do not reach the port. A few handsome buildings adorn its *pracas* (the Portuguese word for plaza), and include the president's palace. There are shipbuilding yards and manufactures of cotton, shoes, stoves, furniture, paper and soap. The climate is cool in winter and very hot in summer; the extremes of temperatures recorded in a period of 10 years were, respectively 29° and 103° F. The mean annual temperature is 67° F. The annual rainfall is about 31 in. Porto Alegre was founded in 1742 by Portuguese immigrants from the Azores. Pop. 1920, 179,263; est. pop. 1930, 273,376.

PORT OF SPAIN, also Spanish Town, capital city of the Island of TRINIDAD, in the British West Indies. The city is located on the west coast on the Gulf of Paris. It has a good harbor, wide thoroughfares and many impressive edifices, among them the Government House and the Protestant and Catholic churches. There is also a botanical garden. Rum, sugar, cocoa, coconuts, copra, kerosene and crude petroleum are the principal exports. Pop. 1931, 70,077.

PORTO-RICHE, GEORGES DE (1849-1930), French dramatist, was born at Bordeaux, May 20, 1849, of Italian parents. In his youth he settled in Paris, where he published his first poems, *Prima verba*. He was appointed librarian of the Paris Arsenal, 1906. His first two plays, *Le Vertige*, 1873, and *Un drame sous Philippe II*, 1875, made little impression but a one-act play, *La Chance de Françoise*, 1889, immediately brought him into theatrical promi-

nence. Thenceforth his success was steady. *L'Infidèle*, 1890, *Amoureuse*, 1891, a moving contemporary tragedy-comedy, and *Le Passe*, 1898, he collected in 1898 under the title *Théâtre de l'amour*. His masterpiece, *Le vieil homme*, 1911, describes a conflict between a father and son, both enamoured of the same woman. He died in Paris Sept. 5, 1930.

PORTO RICO, an island territory of the United States, one of the WEST INDIES, about 480 mi. east of Cuba and about 1,400 mi. southeast of New York. The Atlantic Ocean bounds it on the north and the Caribbean Sea on the south. It is generally rectangular in shape, about 100 mi. long from east to west, 30 to 40 mi. wide, with an area of about 3,500 sq. mi. This island is the smallest of the Greater Antilles and the most densely populated. The 1930 census reported 1,543,913 inhabitants, averaging 449.5 to the sq. mi., an increase of 18.8% over 1920 and about 83% over 1899. Pop. 1920, 1,299,809; 1910, 1,118,012; and 1899, 953,243. The people are 73% white and 27% Negro and Mulatto. The island is divided into 77 municipalities for the purpose of local government. There are 74 towns and three cities. SAN JUAN, the capital, is the largest with 114,715 population; PONCE with 53,430 is second in size; and MAYAGUEZ with 37,060 is third.

Surface Features and Climate. Porto Rico rises from low coastal plains on the north and south to an elevated plateau in the interior. It is traversed east to west by a broken series of ridges 1,500 to 4,000 ft. in height and separated by broad fertile valleys. An extraordinary number of small rivers and streams radiate from the interior in all directions to the sea and are important as domestic water supply, water power, and to irrigate the arid lands on the southern coasts. The four sides of the island are uniform with no large inlets or prominent headlands.

Porto Rico escapes tropical heat because of the trade winds blowing almost constantly from the northeast, and the cool sea breezes along the coast. The mean annual temperature is 76.5° F. and is practically constant. The average change from day to night is under 10°. The average annual rainfall is about 70 in. and the average humidity is 70% by day and 85% at night. The rainy season begins in summer with the greatest precipitation from Sept. to Nov. The island is in the storm belt of the Caribbean Sea and subject to occasional hurricanes. That of Sept. 13 and 14, 1928, was unusually disastrous, killing 271 people and injuring more than 3,000. Fully one-third of the people were made destitute through destruction of property and crops.

Soil and Mineral Resources. The prevailing soil formations are mixed volcanic and sedimentary rocks in the highlands with extensive deposits of blue limestone of the Cretaceous period. Erosion activity has provided the mountain slopes with a deep layer of reddish clay that is not washed away by water and which permits cultivation to the top. The coastal plains have a rich alluvial soil.

Minerals are found in considerable variety but none

in large quantities. Those being developed consist of manganese, limestone for building, clays for brick and pottery, and gypsum for stucco, plaster and fertilizer. The placer gold deposits were practically exhausted during the early days of Spanish possession. There are undeveloped deposits of marble and lignite and extensive phosphate beds on the southern side. Copper and iron are found but the quantities are unknown.

Flora and Fauna. Porto Rico was once probably densely wooded but the indigenous vegetation has mostly disappeared under cultivation. Remnants of the primeval forests are still found on the higher slopes and contain varied and beautiful trees including ebony, Spanish cedar, sandalwood, rosewood, auburn and mahogany. In addition there are medicinal plants and dyewoods such as chicory, indigo, vanilla, castor, ginger, mallow, patchouli, salvia, elder and aloe. A national forest reserve is located at Luquillo.

Virtually all the indigenous mammals and other wild animals have become extinct. Several species of lizards and one specie of snake exist, all harmless. The rivers contain numerous varieties of fresh water fish, some of which are edible. Domestic animals have been introduced into the island; in 1931 livestock included 280,000 cattle, 137,000 swine and 57,000 horses, mules and donkeys.

Agriculture and Manufactures. Agriculture is the chief industry and most of the land is under cultivation. In 1930 there were 53,115 farms devoted chiefly to producing sugar, coffee, tobacco, coconuts and citrus fruits. Cotton and various textile fibres are grown. For the year ending June 30, 1931, estimated production of the principal crops was sugar, 886,000 short tons; tobacco, 24,000,000 lbs.; and coffee 8,000,000 lbs. The latter figure is below half the normal crop due to destruction of coffee trees in 1928.

The important manufactures of the island are sugar, cigars and cigarettes, linen clothing and fine needlework, straw hats and canned fruits.

Trade and Transportation. For the year ending June 30, 1931, the commerce with foreign countries amounted to \$174,838,337, of which about 92% was with continental United States. Imports totaled \$83,921,829 and exports \$99,646,658, making a favorable balance of trade. The principal exports to the United States were sugar, \$54,366,133; needlework, \$13,202,513; leaf tobacco, \$13,165,247; fruits, \$4,779,194; cigars, \$3,408,721; coconuts, \$232,388; and coffee, \$488,846. The last two items represent only a fraction of the normal export value, the shrinkage being due to the 1928 hurricane destruction. Coffee exports totaled \$5,747,932 in 1926-27 and \$2,596,872 in 1927-28.

Imports included rice, wheat flour and other grain products, cotton manufactures, iron and steel and meat products.

Vessels in foreign trade entering Porto Rican ports in 1929 numbered 1,149, of which 627 were American. The vessels cleared totaled 1,175. Air mail and

passenger service is in operation from Porto Rico to the United States and South American points. Within the island in 1930 there were about 335 mi. of railways, 1,700 mi. of surfaced roads, 1,098 mi. of telegraph wire and 28,942 mi. of telephone wire.

Government and Finance. Porto Rico is administered under the Jones Act passed by the United States Congress in 1917, which gave executive power to a governor appointed by the President, and legislative power to a legislature of two houses. The Senate has 19 members and the House of Representatives 49. Both are elected for four years by direct vote. There are eight executive departments, justice, finance, interior, education, agriculture, labor, commerce and health, the heads of which form an executive council presided over by the governor. The island elects for a term of four years a resident commissioner to Washington with a voice but no vote in the U.S. House of Representatives. The Jones Act granted United States citizenship and conferred manhood suffrage. In 1929 the legislature extended the franchise to women over 21 who can read and write.

The government budget for 1930-31 provided for expenditures of \$10,451,000 from an estimated revenue of \$10,500,000. The Federal Government makes substantial contributions to the island by maintaining certain government services and by exempting the people from practically all Federal taxes. The island can levy its own taxes and receives the net proceeds of its customs collections. According to the governor's report at the opening of the legislature Feb. 10, 1930, the net insular bonded indebtedness was \$25,390,000 and the floating indebtedness about \$3,024,950. In addition the municipalities had a bonded indebtedness of \$18,314,000.

Education. The public school system provides free and compulsory education for children between the ages of eight and 14. In 1930-31 the total enrollment in all public schools was 221,438 of whom 7,054 were in high schools. Teachers numbered 4,451. In addition, 5,728 children attended 31 private schools.

Total expenditures for public schools from all sources were \$5,928,303.27. Educational facilities are constantly being improved and illiteracy has been reduced to less than 30% from 83% in 1899 when the free school system was introduced. Night schools for adults are conducted in both rural and urban districts, and the day schools provide children with occupational training. There are industrial schools at San Juan and Ponce offering courses in printing, plumbing, electricity, agriculture, needlework and music. The University of Porto Rico at Rio Piedras affords higher education.

Social and Economic Conditions. Standards of living have been greatly improved since 1899 but over-population has created a state of chronic unemployment. In 1929, according to the insular Bureau of Labor, of the 460,940 available workers, 170,519 or 37%, were unemployed. To reduce this the

government has inaugurated a system for the purchase of land from large estates to be distributed in small holdings, and employment has been further stimulated by the appropriation by United States Congress of \$2,000,000 for road work. Also, in 1930 a law was passed exempting new industries from taxation for not over ten years.

Absentee landlordism as practiced by American financial interests owning large sugar plantations, is considered chiefly responsible for the poverty of the masses. Great numbers of the rural population are employed on these plantations and earn approximately 70¢ a day, four days out of seven, or an income of from \$250 to \$275 per year. This condition has contributed to a Nationalist movement but there is a division of opinion as to whether statehood, autonomy or independence would be most beneficial.

HISTORY

When CHRISTOPHER COLUMBUS landed on the western coast of Porto Rico, Nov. 19, 1493, he named the island San Juan Bautista. JUAN PONCE DE LEON in 1508 gave to the bay, afterwards known as San Juan, the name of Puerto Rico. Usage curiously transposed the names of island and bay. With colonists and supplies from Santo Domingo, Ponce de Leon founded the settlement of Caparr; it was abandoned in 1511 when San Juan de Porto Rico was established on a more healthful location. The island was declared a royal province of Spain in 1509, and Ponce de Leon appointed first governor. Fortification was begun in 1533; La Fortaleza, Morro Castle, San Cristobal, and other works were erected at strategic points. Yet SIR FRANCIS DRAKE sacked San Juan in 1595, as did the Earl of Cumberland three years later. A third English attack, led by Lord Abercrombie in 1797, was repulsed. The aborigines, impressed into the quest for gold, rapidly declined; by 1582 no natives remained on the island. The supply of gold was practically exhausted early in the colonial period. The colony languished until in the middle of the 18th century Spanish colonists and Negro slaves arrived in considerable numbers.

Porto Rico, like Cuba, remained aloof from the general insurrection of the Latin American colonies in 1810-11. Spanish refugees from the mainland settled in the colony, strengthening its conservative trend. But when Ferdinand VII repudiated the Spanish constitution of 1812, under which the island had sent delegates to the Spanish Cortes and had enjoyed a measure of local autonomy, the first symptoms of revolution appeared, to be quickly crushed. In 1867 another outbreak failed to enlist popular support. Two years later Porto Rico regained the privilege of sending elective representatives to the Cortes. Slavery was abolished by the Spanish Government in 1873. Incidental to the prosecution of the SPANISH AMERICAN WAR, an American military expedition under Gen. NELSON A. MILES landed on Porto Rico on July 25, 1898, and gained control without encountering serious resistance; in the Treaty of Paris which

closed the war, the island was ceded to the United States. The provisional occupation, with Gen. John R. Brooke as military governor, was ended on May 1, 1900, when Civil Government was instituted under the provisions of the Foraker Act. (See INSULAR CASES.) The Olmsted Act, July 15, 1909, placed supervision of Porto Rican affairs in an executive department of the United States to be designated by the President. President Taft selected the War Department. Under the Jones Act, which became effective on Mar. 2, 1917, Porto Rico became a territory of the United States "organized but unincorporated," and United States citizenship was bestowed upon the population collectively.

BIBLIOGRAPHY—Salvador Brau, *Puerto Rico y su historia*, 1894; R. A. VanMiddeldyk, *The History of Puerto Rico*, 1903; W. F. Willoughby, *Territories and Dependencies of the United States*, 1905

PORTO RICO, UNIVERSITY OF, a coeducational institution at Rio Piedras, P.R., founded in 1903. It had its origin in a normal school established after the close of the Spanish American War at Fajardo, on a site donated by the citizens of the town. Because of the necessity of a more central location, the school was moved to Rio Piedras in 1901. Upon the foundation of the university two years later, the normal school was absorbed and became the first department of that institution. The university comprises the College of Agriculture and Mechanic Arts at Mayaguez, colleges of Liberal Arts, Medicine, Education and Law, and a university high school. It receives an annual appropriation for maintenance from the insular legislature, and the appropriation which the Federal Government extends to agricultural and mechanical colleges. The grounds and buildings were valued in 1931 at \$744,453. The library contained 33,200 volumes. In 1931-32 there were 2,159 students and a faculty of 144 headed by Pres. Gildo Masso.

PORTRAIT PAINTING. European. European portrait painting begins with the Venetian painter, Cimabue (1240-1302), who according to Vasari "painted a small picture of St. Francis in panel on a gold ground, drawing it, a new thing in these times, from Nature," meaning that he drew St. Francis from a living model. GIOTTO DI BONDONE (1266-1337) was the influential innovator and was the first to put portraits of friends in his church paintings. From the time of Giotto practically all processional and groups in religious pictures were intended to be likenesses of historic personages or of monks, and all figure painting was essentially portraiture. A well-known example of Giotto's portraiture is a picture of Dante in a fresco depicting Paradise in the chapel of the Bargello, Florence. This fresco was discovered in 1840 under a coating of whitewash. Separate portraiture developed from the practice of portraying the donor in a small scale kneeling in adoration of the Holy Family. The earliest single portrait now extant is that of King John II of France painted about 1359 by Gerard d'Orléans, his valet de chambre.

The great names in Renaissance portraiture are LEONARDO DA VINCI (1452-1519), RAPHAEL SANZIO (1483-1520) and TITIAN (1477-1576). Leonardo, whose *Mona Lisa*, or *La Gioconda*, is considered by many authorities to be the world's finest example of portraiture, was the first painter to appreciate the value of chiaroscuro, or light and dark, and to give to his subjects the appearance of lifelike roundness and modeling. That Raphael could paint masterful secular portraits as well as religious subjects is evidenced by his portraits of Balthazar Castiglione and La Gravida and his group of Pope Leo X with the two cardinals, Giulio de' Medici and Ludovico de' Rosse. Titian of the Venetian school is the greatest portrait painter of the Renaissance. His *La Bella* in the Pitti Palace and *L'Homme au gant* in the Louvre illustrate his creation of an illusion of space about and behind the sitter and his rich yet subdued coloring. Other outstanding portrait painters of the Renaissance are TINTORETTO (1518-94) and Moretto (1498-1555). MORONI (1520-78) was a specialist in portrait painting. His *Tailor* in the National Gallery in London is outstanding for its color and characterization.

The founder of the South Italian and Spanish schools of Naturalists, Caravaggio (1569-1609), copied nature with careful accuracy, incorporating even its more disagreeable aspects, and his work is characterized by exaggerated contrasts of light and shadow. He forms a connecting link between the classicism of the Italian Renaissance and the Dutch and Spanish painters of the 16th century.

The Flemish painters HUBERT VAN EYCK (?-1426) and JAN VAN EYCK (1381-1440) were masters of color and careful realists as illustrated by Jan's portrait *Jan Arnolfini of Lucca and his Wife* now in the National Gallery, London. Tradition credits them with the invention of the oil technique though their contribution undoubtedly consisted in development of the technique and the first successful use of this medium which was to have so vital an effect on portrait painting and art in general.

The portraits of HANS HOLBEIN, the Younger (1497-1543), are frank records of character never softened or modified by the use of light and shade and executed with an almost unexcelled feeling for beauty of line and harmony of color. He belonged to the Swabian school of 16th century Germany painters, though much of his work was done in England where he served as court painter to Henry VIII from 1527 until his death. Among his best portraits are those of Erasmus and of Anne of Cleves, both in the Louvre, and of George Gysse in the Kaiser Friedrich Museum, Berlin.

The Flemish school of the 17th century, with PETER PAUL RUBENS (1577-1640) at its head, was of great influence down to the present century. Various aspects of the genius of the great master are reflected in his pupils of whom ANTHONY VAN DYCK (1599-1641) was the greatest portraitist. Van Dyck's best work was produced in his early years before he be-

came court painter to Charles I and was forced to turn out in such great quantity that his work became obviously mannered. One of his outstanding achievements is the full length portrait of Charles I now in the Louvre. Another of his best works is the portrait of Maria Luis de Tassis now in the Lichtenstein Gallery, Vienna.

During the 17th century, Holland produced a larger number of truly great painters than has ever appeared in any one country during a similar period. The portraits begin with Mierevelt (1578-1641), who is said to be the first painter to support himself solely by portraiture, and continue with Ravensteyn, De Keyser, Van der Helst, FRANS HALS and REMBRANDT VAN RIJN. Rembrandt (1606-69) dominated the school. He was a born naturalist, but in his ability to see qualities in his sitters which the ordinary person does not see he was also an idealist. Light and shade are the determining factors in his composition, the dark shadows shot through with streaks of red or deep rich brown. His subjects are always those who show their character either in their manner or in their faces.

Frans Hals (1580?-1666) was the earliest of the great masters of the Dutch school, and his portraits are his most important achievements. He is the typical jolly Dutchman, full of the simple joys of living, who painted his subjects as their neighbors saw them but with very little philosophical insight. The coloring of Hals is bright and vivacious, and he was a master of brushwork.

Of the Spanish painters of the 16th and 17th centuries, Theotocopuli (1548-1625), better known as El Greco because of his Greek origin, gave sinister cast to his paintings, strangely in keeping with the gruesome period of the Spanish Inquisition. He was the first to elongate his figures for purposes of composition, and in many of his paintings one feels an upward weaving movement, as of fire. DIEGO RODRIGUEZ DE SILVA Y VELASQUEZ (1599-1660) represents the peak of the Renaissance in Spain and is one of the greatest portraitists of all time. His portraits are entirely free from mannerism and are characterized by their fidelity to nature. His palette was dominated by gray tones shot through with silvers, blues, greens and reds. FRANCISCO JOSÉ DE GOYA Y LUCIENTES (1746-1828), the greatest Spanish painter of the 18th century, was unrivaled as a portrayer of national customs. He was a fiery and satirical realist though he used paint in the manner of the impressionists.

The English art which developed in the 18th century was a frank evolution from the foreign artists upon whom England had depended, and embodies the best as well as some of the worst traditions of Holbein, Rubens, and chiefly of Van Dyck. Sitters were portrayed in graceful flowing costumes and in pleasing postures frequently against a tapestry-like landscape background. Full length portraits are characteristic. WILLIAM HOGARTH (1697-1764), the moralist, who appeared in the early part of the 18th century,

is the first English painter of real merit. SIR JOSHUA REYNOLDS (1723-92) and THOMAS GAINSBOROUGH (1727-88) are the great names in this school. *Nellie O'Brien*, a lady with a bewitching smile, is representative of Reynolds' best work; *Perdita* and *Mrs. Siddons*, of Gainsborough's. GEORGE ROMNEY (1734-1802) was close to the perfection of Reynolds and Gainsborough. His *Parson's Daughter* shows a rare mastery of youthful grace. Other portraitists of this period are SIR THOMAS LAWRENCE, Hone, Hopner, Abbot and the Scotsmen Allan Ramsay and SIR HENRY RAEBURN.

The founder of 19th century or modern British painting, SIR JOHN EVERETT MILLAIS (1829-96), was the first to break away from the Pre-Raphaelite Brotherhood which he had established with Dante Gabriel Rossetti and WILLIAM HOLMAN HUNT. He developed his own style, which is characterized by great variety and vividness of color, and is almost unique among portrait painters in that there is no trace of family resemblance among his portraits. Frank Holl (1845-88), a rival of Millais, and one of the most remarkable portraitists of the 19th century, generally chose men for his subjects. The portraits of GEORGE FREDERICK WATTS (1817-1904) show deep insight into character but little concern for color. SIR WILLIAM ORPEN (1878-1931) was a direct painter who incorporated in his portraits not only what he saw but what he felt.

The first important French portrait artists were Jean Clouet (1485-1541) and François Clouet (1500-72), father and son who flourished in the 16th century and developed a style more influenced by the Netherlands and Germany than by Italy. Superficial elegance which had been introduced by inferior Italian painters was the keynote of the so-called School of Fontainebleau to which Jean Cousin, the only other French painter of consequence of this century, belonged.

Seventeenth century painting began with Vouet (1590-1649), a follower of the Italian school and the teacher of Eustache Le Sueur, Pierre Mignard and CHARLES LE BRUN, all of whom did some portrait work. Rigaud and Largillière were the representative portrait painters of the reign of Louis XIV. They were succeeded in the 18th century by De La Tour, Nattier, Toque and Madame Le Brun. De La Tour (1704-88) devoted himself to the development of pastel technique. MARIE ANNE VIGÉE-LEBRUN (1755-1842) succeeded Nattier as favorite court painter.

JACQUES LOUIS DAVID (1748-1825), who dominated French art during the last quarter of the 18th century and the first quarter of the 19th, was at his best as a portrait artist. He was an ardent classicist more preoccupied with form than color and making many of his canvases stiff and formal. His portraits, however, of which Mme. Recamier and Mlle. Charlotte du Val d'Ognes should be mentioned as outstanding, are generally characterized by freshness, charm and vivid personality. JEAN AUGUSTE INGRES (1780-1867), David's greatest pupil, was also at his best in portraits, and an adherent of the Classicist school.

Eugène Delacroix (1798-1863) championed the opposing school of Romanticists. He contended that "to be a feast for the eyes is the first merit of a picture" and his paintings are vibrant with color. Though not primarily portraitists, JEAN-BAPTISTE COROT (1796-1875), and the Impressionists Edouard Manet (1832-83), HILAIRE G. É. DEGAS (1834-1917) and Renoir (1841-1919) achieved some remarkably beautiful works in this specialized field, as did PAUL CÉZANNE (1839-1906), that genius who was so completely absorbed in the expressing of form in pure color that anatomy and drawing frequently took second place.

The development of photography has had a deleterious effect upon the portrait painter's art; but of contemporary painters doing some portrait work the following should be mentioned: the Frenchman, André Derain (1880-); the Spaniards, IGNACIO ZULOAGA (1870-) and Hermenegildo Anglada-Camarasa (1872-), the Germans, Karl von Haffner (1880-) and Max Beckmann (1884-), and the Englishmen, Gerald Leslie Brockhurst (1890-) and Frank Salisbury (1874-). Pablo Picasso (1881-) won the Carnegie Prize in 1930 with a portrait of Madame Picasso.

American. The first development of art in America was in the field of portrait painting. The Puritans and Quakers, unlike the cultivated French cavalier colonists, brought with them a strong religious prejudice and indifference to all that did not contribute to conquering their surroundings, in place of artistic appreciation and possessions. As the struggle for mere existence ceased to be acute, the vigor of this pioneer spirit showed itself in an ambition to found families and states; and there arose the desire to leave a record to posterity in the form of family portraits, without regard to their artistic quality. The Dutch about New York had a broader culture, but they did not lose the native Burgher traits of interest in their own portraits and concentration on trade rather than the beauty of their surroundings.

The so-called Primitives were the limners or face painters before 1740; they were unskilled foreign artists or amateur natives, wandering craftsmen whose real vocation was the painting of signs and carriages. Their conscientious, literal likenesses, unidealized and uninfluenced by art formulas or traditions, are valuable chiefly as historical documents, giving as they do the human aspect of the beginnings of American life such as is found in no written record. There is also a quaint charm in some of the native unsigned work; this is true, for example, of *Madam Elizabeth Freake and Baby Mary*, over and above the historical value it possesses as a revelation of the prosperity of the times, evidenced by the rich lace and fabrics. Among the artists of this period whose names are known are William Read, first face painter of New England, James Claypoole, first native painter of Pennsylvania, Charles Bridges, John Woolaston, Nathaniel Emmons, John Watson and Gustavus Hesselius. Among the Dutch painters about New York were: Strycher, painter of Van der Donck, the founder of Yonkers; Vanderlyn, painter of Johannes Van

Vechten, and Duyckinck, painter of Mrs. Augustus Jay.

John Smibert stands as the connecting link between the early and later Colonial periods of painting. He accompanied Bishop Berkeley to America, and on the passage made studies for the figure group of the bishop and his family, comprising eight persons. This, with his portraits of Jonathan Edwards and Gov. Endicott of Massachusetts, brought him fame. Lawrence Kilburn, Robert Feke, Mathew Pratt, Abraham Delano, Henry Benbridge, Johnathan Blackburn and Peter Pelham, painter of Cotton Mather, were of this time. The four native-born artists who established a characteristic school of American portraiture were John Copley, Benjamin West, Charles Peale and Gilbert Stuart.

Copley is more closely identified with the period from 1740 to 1790, and was the only great painter before the Revolution. His peculiar importance lies in the record he left of his time in the long series of paintings of divines, colonial dignitaries and wealthy merchants, together with the women of their families. The uninspired precision and uncompromising integrity with which he put down each detail as he saw it, in the clear bleak New England atmosphere, give a value to these pre-Revolutionary relics greater than any idealized portraits with more facile and impersonal technique. The force of character stamped on the faces of both men and women presents a truer account of these "stones in the foundation" of the nation than any documentary evidence. Class distinction began to make itself felt and Copley, strong with this feeling, delighted to give an aristocratic if rigid charm to his sitters, as in his young *Lady Wentworth* and the older *Mrs. Fort*. It was an irremediable loss to the historian and biographer when he went to live in England. Here he acquired greater skill through the comparison of his work with that of superior craftsmen, but in acquiring the English technique he lost in characteristic strength, and his importance to the history of American portraiture ended. Charles Peale filled the gap between Copley's departure for England in 1774 and the return of Stuart in 1793. His celebrity lies in his 14 portraits of George Washington in the sitter's prime and vigor. As a captain of volunteers, Peale was able to present a more intimate aspect of the Commander-in-Chief while in action. His brother James and his sons, Rembrandt, Raphael and Titian carried on the family artistic tradition. Benjamin West was the first native artist to give prestige to American art in Europe. Leaving the country of his birth at 22 to live permanently in England, a dexterous, but never a master craftsman, the stream of American art flowed through his painting rooms for 60 years. Throughout this period he was court painter for George III, and persuaded that monarch to found the Royal Academy. He was its second president, the only American to hold that position. He was responsible for a far-reaching art innovation. In his *Death of General Wolfe after the Capture of Quebec*, he clothed the

figures in the costume of the times. Heretofore Greek and Roman draperies had been used for historical pictures of this character. But his real power was as counselor and helper to the many young American painters who came to him for training and aid.

GILBERT STUART was the first master of American painting, the creator of superb portraits of a great host of historical Americans. His *Mrs. Richard Yates* is unique in character interpretation and brush work. He is best known by his portraits of George Washington. The first, considered best by Mrs. Washington and the artists of to-day, is the so-called Vaughan portrait, owned by the late Thomas B. Clarke, the outstanding authority on early American portraiture; several copies of this still exist. The Hamilton and Lansdowne portraits as well as the *Dorchester Heights* are full length portraits. The best known is the Athenaeum head, popularly called the postage stamp Washington, as it is familiar on the coinage and stamps in circulation. More than 50 copies of this head were made by Stuart, who purposely never finished it, as he had promised it to Mrs. Washington when completed. Stuart's technique was his own. He had no stereotyped formula and detested repetition, even in his inveterate copying. He confined himself to face painting, concentrating on a sympathetic interpretation. He gave slight heed to the accessories of clothes, background or unusual lighting.

The early Republican period of portraiture in which Stuart stood in the van, was one of creditable technique, but with a tendency to "prettify" the subject and produce handsome family likenesses. Of this period were John Trumbull, John Jarvis, Chester Harding, Henry Inman, Samuel Waldo, John Nagle, Rembrandt Peale, Robert Fulton, inventor of the steamboat, Samuel M. Morse, inventor of the telegraph, John Vanderlyn, Asher Durand and Washington Allston. The period ended gloriously with Thomas Sully. After the Civil War interest in portraiture waned; the enlarged tinted photograph and the daguerreotype sufficed for the people in general, and the wealthy acquired a taste for foreign art. Of this period were William Page, Charles Elliot, Henry Gray, Eastman Johnson, George Healy and William M. Hunt.

John Sargent (1856-1925) stands as one of the great luminaries of American portraiture. He painted a prodigious number of brilliant portraits of the celebrated personages of the day. James Whistler was master of many branches and media of art, but his reputation might stand alone on his portraits of his mother and of Thomas Carlyle. The Munich technique was transmitted through Frank Duveneck, the so-called "Great Teacher of the West," and William Chase, the "Great Teacher of the East." John Alexander was also a representative of Munich although his art is considered to be characteristically French. Among the Paris-trained are Kenyon Cox, Abbot Thayer, George deForest Brush, Will Low, Carroll Beckwith, Frank Benson, Edmund Tarbell, George

Tarbell, George Hitchcock, Thomas Dewing, Irving Wiles, Robert Henri, Robert Blum and Douglas Volk.

Foremost among the professional portrait painters stand two women, Cecilia Beaux and Mary Cassatt. Cecilia Beaux, in large measure self-trained, carries on the general tradition of Sargent, and is the last after him, and so the fourth American, to be invited by the Italian Government to paint a self-portrait for the Uffizi Gallery, Florence, where hang the self-portraits of Titian, Rubens, Van Dyck and Rembrandt. She painted three great figures of the World War, Clemenceau, Cardinal Mercier and Admiral Beatty. Mary Cassatt is of the Impressionistic School and a painter of women and children. Wilton Lockwood in his portrait of La Farge revealed his debt to that master's training. Miniature painters of the early Republican period and those of to-day are dealt with in *MINIATURE PAINTING IN AMERICA*.

Other outstanding portrait painters at the present time are Gari Melchers, Robert Vonnoh, George Luks, Edwin Child, William Paxton, Charles Hopkinson, Charles Hawthorne, Henry Hubbell, Eugene Speicher, John Johansen, Julian Lamar, Louis Betts, Wayman Adams, Joseph Chase, Karl Anderson, Leopold Seyffert, Harriet Blackstone, Ralph Clarkson, Howard Hildebrandt, Ernest Ipsen and Albert Sterner.

BIBLIOGRAPHY.—E. R. Abbot, *Great Painters*; H. E. Furst, *Portrait Painting*, J. C. Van Dyke, *A History of Painting*, E. von Mach, *Outlines of the History of Painting*.

PORTRAIT SCULPTURE, a sculptured work of art representing an individual. The first examples of true portraiture are the statues which the Egyptians of the Old Empire placed in the tombs with the body and mortal effects of the departed. The statues were realistic representations of the person whose spirit they were meant to comfort, and they also satisfied fundamental laws of art. A good piece of portrait sculpture must go beneath the surface characteristics, such as detail of physiognomy, and represent the essential character, the soul and personality of the subject. Rodin delighted in quoting Latour's jibe at his wealthy patrons, which illustrates this point: "They believe I record only their features, but I really reach down to the very depths of their being and express exactly what they really are." And in addition to expressing the character of the individual, the portrait must be a work of art.

The Greeks of the 5th century B.C. were so absorbed in their passion for beauty and harmony that they idealized their subjects, making them closely akin to the gods and sacrificing individuality to art. Of Phidias's bust of Pericles Pliny said that it showed how an artist could "make noble men still nobler." Strictly speaking there are no portraits from the 5th century B.C. The identified examples from this period are of Pericles, Socrates, Herodotus, Thucydides, Anachreon, Sophocles and Euripides. Sculpture in Greece received its chief impetus from the desire to honor outstanding men of achievement. In Egypt and Rome it was originally inspired by religious fervor and by self-glorification of individuals.

Roman sculpture emphasizes the human side of the individual and is realistic to the last furrow on the brow and wart on the nose. It inherited much from the Etruscans, who were extreme naturalists. Heads of Pompey and Cicero and a statue of the Emperor Augustus represent Roman portrait sculpture at its best when it was influenced by Greek idealism.

The outstanding portrait sculptors since classical times are GIOVANNI LORENZO BERNINI (1598-1680) and JEAN ANTOINE HOUDON (1741-1828). Bernini, who made his headquarters in Rome, developed the Baroque style and acquired a technical skill which has rarely if ever been equaled. His best known works are busts of his first patrons, Pope Paul V and Scipione Barghesi, and of Constanza Bounarelli, his *innamorata*. Famous also are his effigies of Pope Urban VIII and Alexander VII in St. Peter's. Houdon is one of the world's greatest masters of portrait sculpture. His portraits show a balance between individualism and idealism and are true works of art. His best known work is a seated statue of Voltaire in the Theatre Français, Paris. Houdon did many portraits of Americans including Washington, at the capital at Richmond, Virginia; Franklin, at the Metropolitan and Boston Athenaeum, and Paul Jones, at the Pennsylvania Academy of Fine Arts.

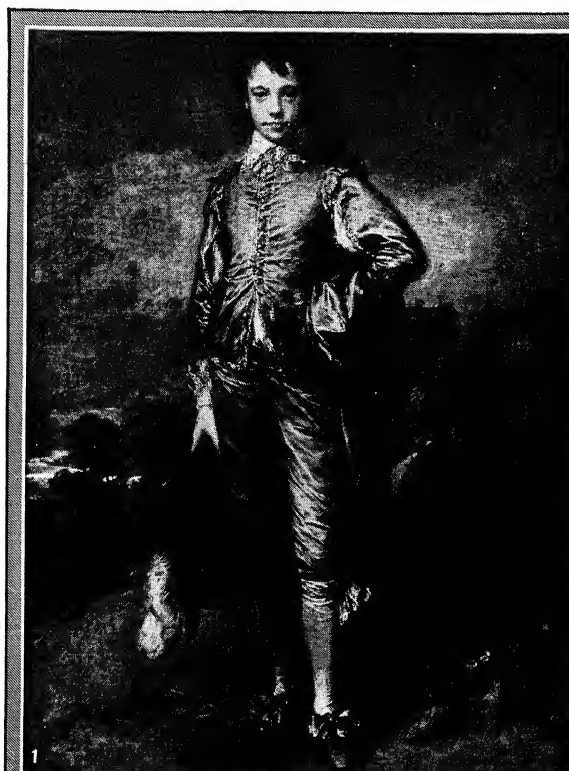
The Hall of Fame of New York University in New York City is a symposium of the work of leading American sculptors. The Hall, at present, contains 69 busts of famous Americans. Among the sculptors represented and their busts are Abraham Lincoln, by St. Gaudens, founder of the American School; Franklin, by Lorado Taft; Edgar Allen Poe, by Daniel Chester French; John Marshall, by Herbert Adams; and Admiral Farragut, by Charles Krafly. Another noted collection of American sculpture is in Statuary Hall of the Capital building at Washington, D.C., which contains two "favorite sons" of each state in the Union. JO DAVIDSON, an American sculptor, has done more portraits of notable people, especially Americans, than any other sculptor living today. In England, JACOB EPSTEIN has made portrait records of a great many Europeans of prominence. Perhaps the most notable portrait sculpture of the 20th century is being done by CHARLES DESPIAU, a Frenchman.

BIBLIOGRAPHY.—G. H. Chase and C. R. Post, *A History of Sculpture*, 1924; Lorado Taft, *History of American Sculpture*, new ed., 1924.

PORTS, like HARBORS, are places of refuge for shipping. But in addition to the physical features of harbors they include facilities for loading and discharging ships and for furnishing fuel and supplies. A port usually includes a community, and is legally an officially designated point at which commerce and persons may enter and leave a country under the supervision of customs, immigration and other governmental services.

Free Ports—free or foreign trade zones—are ports or designated areas in a port in other than a free trade nation into which goods may be imported, stored, graded, packed or in some cases processed,

PORTRAIT PAINTING



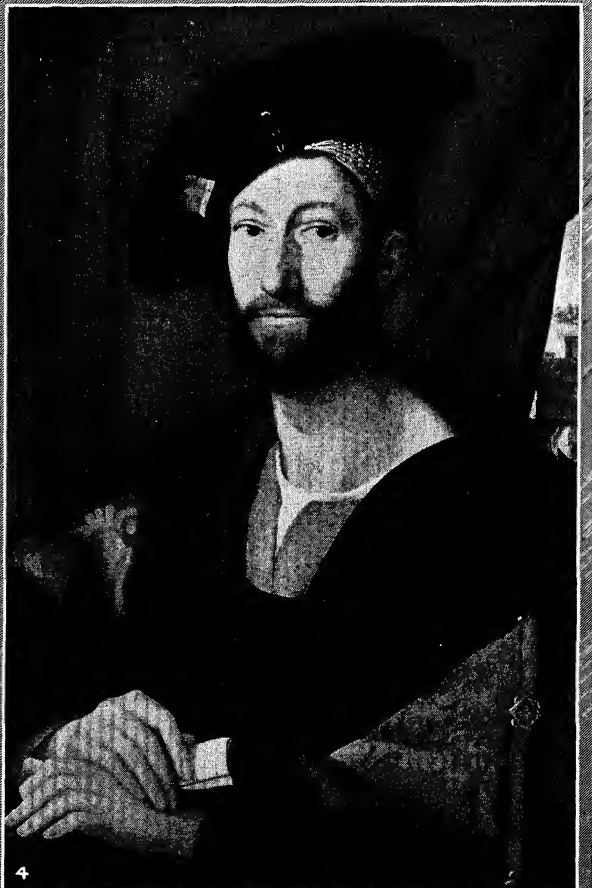
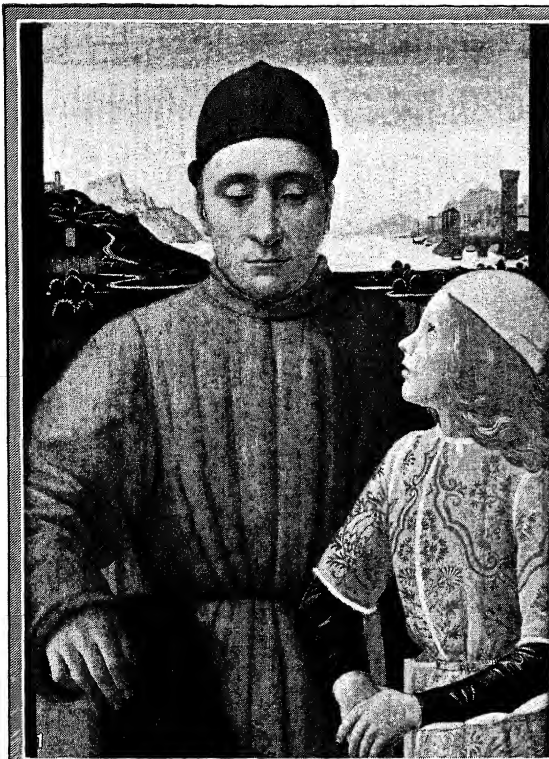
2, COURTESY JULES S. BACHE COLLECTION; 3, MUSEUM OF MODERN ART, NEW YORK; 4, ART INSTITUTE OF CHICAGO

FRENCH AND ENGLISH PORTRAIT PAINTING

1. "The Blue Boy," by Thomas Gainsborough (1727-1788), in the Henry E. Huntington Gallery, San Marino, California. 2. "Le Billet Doux," by Jean Honoré Fragonard

(1732-1806). 3. "Portrait of the Artist's Sister," by Paul Cézanne (1839-1906). 4. "La Lecture Interrompue," by Jean-Baptiste Camille Corot (1796-1875).

PORTRAIT PAINTING



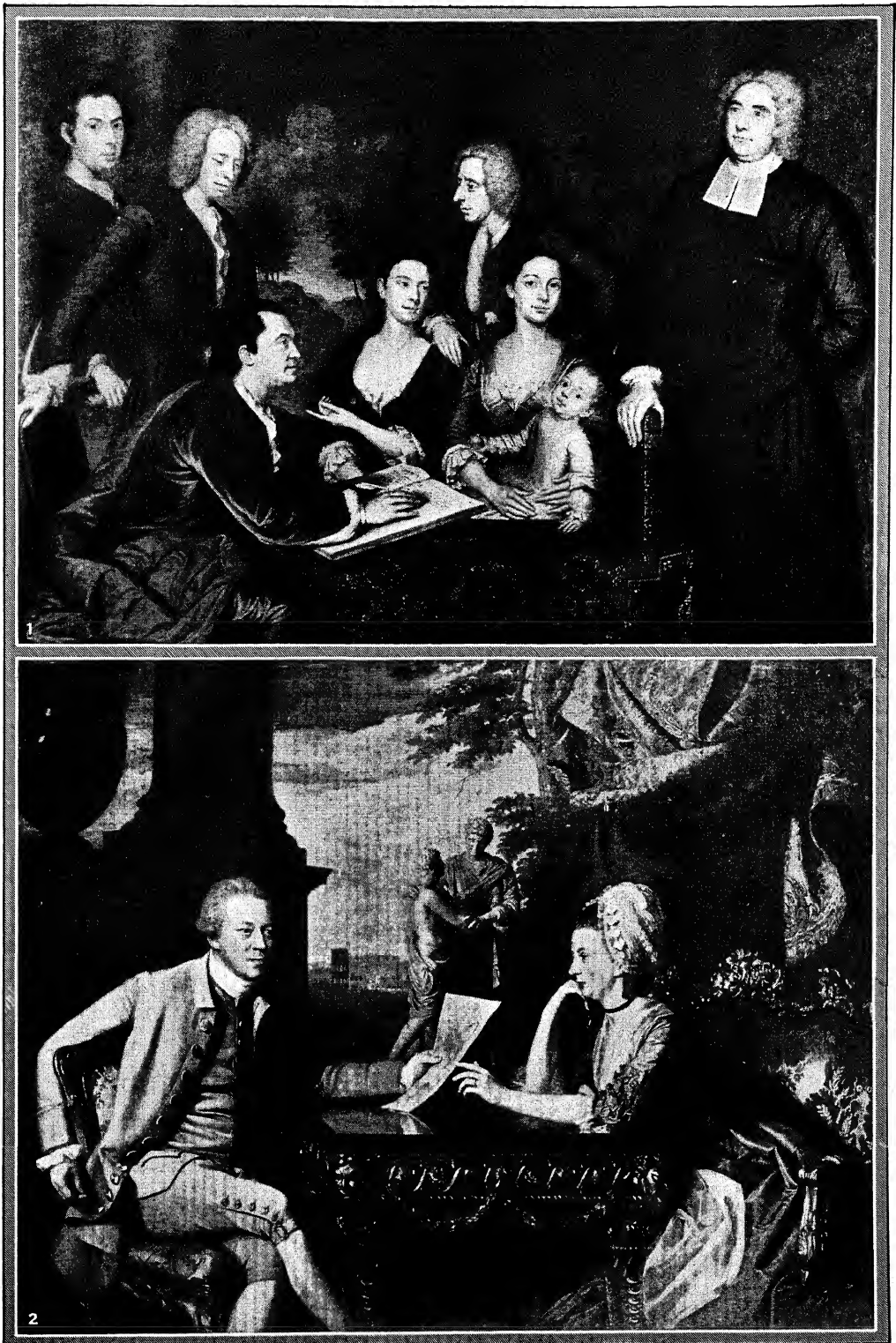
1, 2, 4. COURTESY OF THE JULES S. BACHE COLLECTION, NEW YORK

MASTERPIECES OF ITALIAN AND GERMAN PORTRAIT PAINTING

1. "Francesco Sassetti and His Son Teodoro," by Domenico Ghirlandajo (1449-94). 2. "Edward VI, when Prince of Wales," by Hans Holbein, the Younger (1497-1543).

3. "Portrait of the Artist," by Albrecht Dürer (1471-1528), in the Prado, Madrid. 4. "Giuliano de' Medici, Duke of Nemours," by Raphael (Raffaello Santi) (1483-1520).

PORTRAIT PAINTING



1. COURTESY OF THE GALLERY OF FINE ARTS, YALE UNIVERSITY; 2. MUSEUM OF FINE ARTS, BOSTON

EARLY AMERICAN PORTRAIT PAINTING

1. "Bishop Berkeley and His Family," by John Smibert (1688-1751). Painted in 1729, this is probably the first group portrait made in America.
2. "Mr. and Mrs. Ralph Izard," a portrait group by John Singleton Copley (1737-1815).

PORTRAIT PAINTING

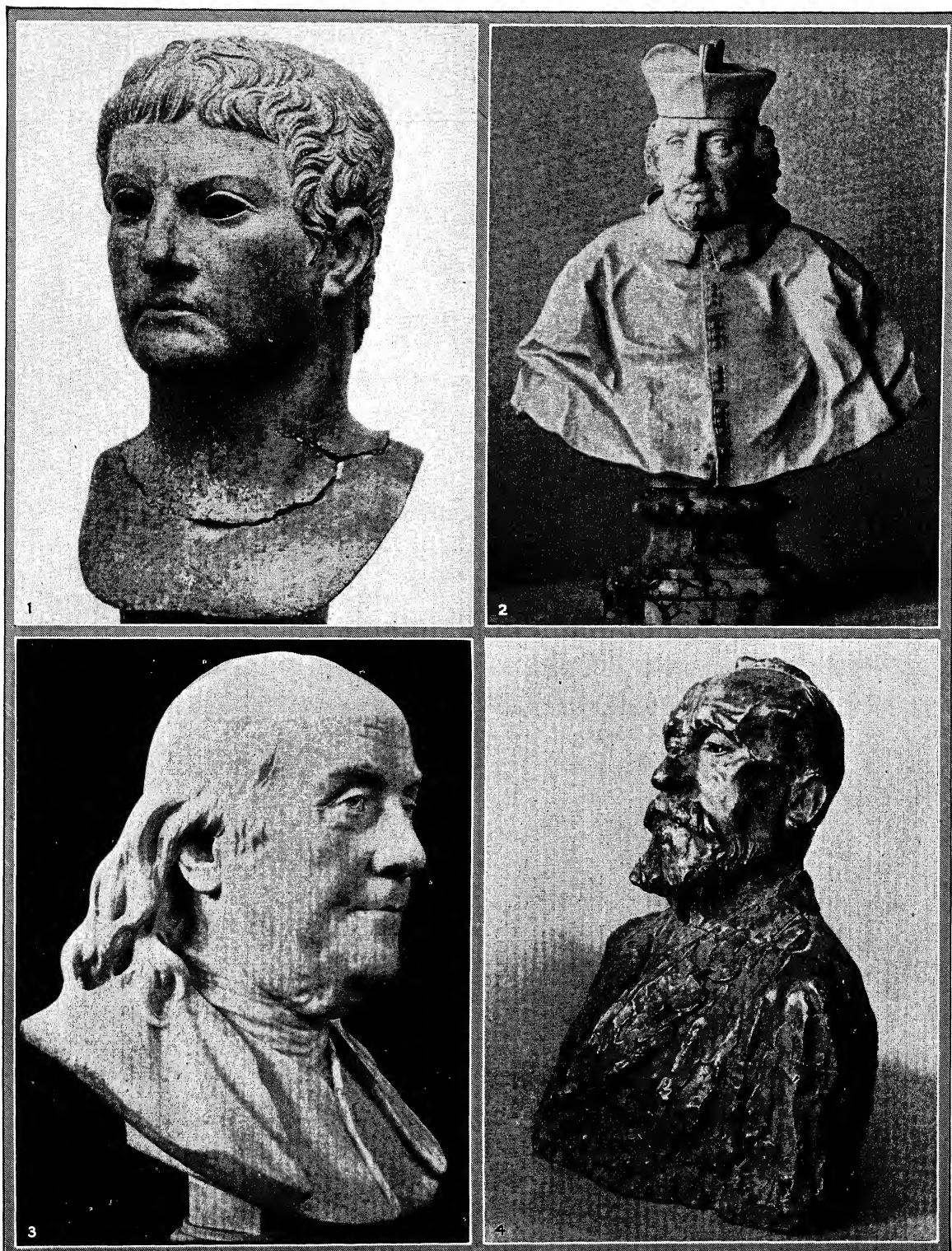


1, COURTESY MUSEUM OF FINE ARTS, BOSTON; 2, 3, METROPOLITAN MUSEUM OF ART; 4, COLLECTION OF MR. AND MRS. LESLEY GREEN SHEAFER

NOTABLE EXAMPLES OF AMERICAN PORTRAIT PAINTING

1. "Mrs. Richard Yates," by Gilbert Stuart (1755-1828).
2. "Portrait of a Young Lady," by Abbott Thayer (1849-1921).
3. "The Wyndham Sisters," by John Singer Sargent (1856-1925).
4. "Jeanne and Lydia," by Eugene Edwards (1883-1925), one of the leading contemporary artists of America.

PORTRAIT SCULPTURE



COURTESY METROPOLITAN MUSEUM OF ART

BUSTS BY THE MASTERS OF PORTRAIT SCULPTURE

1. Agrippa (a bronze fragment found at Susa near Turin, Italy). 2. Cardinal Raimondo Capizucchi, by Lorenzo Bernini (1598-1680). 3. Benjamin Franklin, by Jean Antoine Houdon (1741-1828). 4. Puvis de Chavannes, by Auguste Rodin (1840-1917).

and re-exported without customs restriction or assessment of duty. Free ports, or free trade cities, e.g., Leghorn, Naples, Genoa, and Marseilles, existed on the Mediterranean in the 16th and 17th centuries and in Northwestern Europe as early as the 15th century, e.g., the Hanseatic free cities. Among modern free ports are those of Hamburg, Bremen, Emden, Copenhagen, Stockholm, Malmo, Danzig, Barcelona, Cadiz, Fiume, Trieste, Genoa, Naples, Venice and other famous cities. Well known modern free trade cities include Hong Kong and Singapore.

There are no free ports in the United States although some of the purposes are partially served by "storage in bond," and by the "drawback" which permits re-exporting imported goods with refunding of customs duty.

A *complete port* of importance includes everything necessary to the carrying on of trade in the most economical manner, as well as complete facilities for the repair of shipping, a good supply of labor and adequate provision to enforce government regulations. The *hinter-land* of a port is its tributary territory. It should aid economical transportation through that port, in comparison with other competitive ports. The "Port Authority" attends to the co-ordination of port planning and development, the co-ordination of terminal and transportation facilities, the provision and operation of public terminals and transportation facilities, co-operates in and regulates—consistent with national requirements—the navigation and commerce of the port, issues regulations governing marine and land transportation companies, private terminal companies and others. F. R. H.

BIBLIOGRAPHY—R' S MacElwee, *Port Development*, 1925, and *Port and Terminal Facilities*, 1926; Corps of Engineers, USA and U.S. Shipping Board, *Foreign Trade Zones*.

PORT SAID, a seaport of Egypt at the Mediterranean entrance of the Suez Canal. The building of the city as a terminal port was begun simultaneously with the canal in 1859. There is an outer harbor formed by two piers reaching out to the sea, each terminated by a lighthouse. Port Said harbor has grown from 160 acres in 1869 to its present size of 730 acres; the entrance channel, formerly 65 yds. wide and 25 ft. deep, has been enlarged to a width of 400 yds. and a depth of 40 ft. Port Said commands the short route between western Europe and the Indian Ocean and is a great nodal point for world shipping. It is a coaling station of enormous importance, and obtains fuel from England. The port has a considerable *entrepôt* trade, particularly in cotton, and is the second in importance in Egypt. About 15% of the value of Egypt's imports and 2% of the exports pass through Port Said, as well as more than half the transit trade. Suez Canal dues are collected here. Pop. 1927, 104,603.

PORTSMOUTH, a naval station and seaport of England, in the county of Hampshire, situated in an inlet of the English Channel, 74 mi. southwest of London.

Portsmouth was made a city in 1926. It is an

aggregate of four towns, Portsmouth, Portsea, Landport and Southsea. Portsmouth proper is a garrison town; Portsea is the naval station with dockyards; Landport contains workmen's homes; and Southsea a fashionable seaside resort and residential section. Regarded as the largest naval station in the world, Portsmouth dates from the reign of Henry VIII. The dockyard occupies 300 acres. It is enclosed by a wall 14 ft. high and, entered by a lofty gateway, it includes vast storehouses which contain all the materials requisite for naval architecture; here also are machine shops, extensive slips and docks in which the largest battleships are built or repaired, residences for the officials, and the Royal Naval College. Portsmouth has no manufactures of any consequence, except those immediately connected with its naval establishments. Pop. 1921, 247,284; 1931, 249,288.

PORTSMOUTH, the seaport city in Rockingham Co., southeastern New Hampshire, situated at the mouth of the Piscataqua River, near the Atlantic Ocean. Bus lines and the Boston and Maine Railroad serve the city. There is an airport. Portsmouth has shoe and button factories, gypsum and fertilizer plants. In 1929 the manufactures was approximately \$4,000,000; the retail trade amounted to \$10,069,154. The Portsmouth Navy Yard, one of the oldest and best-equipped in the United States, is situated on Seavey's and Fernald's Islands in the river, within the boundaries of Maine. Submarines are built here. At Portsmouth the final negotiations of the Russo-Japanese War took place. The city has some of the most beautiful examples of Colonial architecture in the country. Portsmouth was settled in 1623; incorporated in 1849. Pop. 1920, 13,569; 1930, 14,495.

PORTSMOUTH, a city of southern Ohio, the county seat of Scioto Co., situated at the confluence of the Ohio and Scioto rivers, at the southern terminus of the Ohio Canal, about 100 mi. south of Columbus and 100 mi. southeast of Cincinnati. The city is served by the Norfolk & Western, the Chesapeake and Ohio and the Baltimore and Ohio railroads, passenger and freight boats, bus lines and a municipal airport. Portsmouth is the commercial center of an important mining section. The surrounding hills are rich in iron ore, limestone, coal, fire-clay, shale and natural gas. Among the chief manufactures are boots and shoes, iron and steel products and brick, their value in 1929 amounting to \$26,000,000. The retail trade in the same year amounted to \$20,901,855. Nearby, extending along the Ohio River for 8 mi., are three interesting groups of the Indian Mound Builders' work.

The first permanent settlers in Scioto Co. came from Pennsylvania in 1796. The town was laid out and founded by Major Henry Massie, who is said to have named it after the New Hampshire home of his friend, Capt. Josiah Sackford. Portsmouth was incorporated as a town Dec. 29, 1814, and in 1851 was granted a city charter. Pop. 1920, 33,011; 1930, 42,560.

PORTSMOUTH, a city in southeastern Virginia although independent, the county seat of Norfolk

Co. It is situated on Elizabeth tidal river, part of Hampton Roads harbor, opposite Norfolk. Bus and truck lines, steamships and six railroads serve the city. Portsmouth does a large shipping trade in oysters and vegetables, and shares the port facilities of Norfolk. The chief manufactures include paper, cotton, hosiery and oil. In 1929 the total factory output was worth about \$11,000,000; the retail trade amounted to \$13,563,506. The state legislature established Portsmouth in 1752 and it became a city in 1858. The city has a United States Navy Yard and one of the largest naval craft building yards in the country. Pop. 1920, 54,387; 1930, 45,704.

PORTSMOUTH, TREATY OF, the Russo-Japanese peace treaty, signed at Portsmouth, New Hampshire, August 30, 1905, which closed the RUSSO-JAPANESE War. The suggestion that Russia and Japan make peace came from President Roosevelt, and both nations were ready to agree because they had very nearly exhausted themselves in the bitter conflict of the preceding year. By the terms of the peace treaty Russia, technically the loser, paid no indemnity but surrendered to Japan her leasehold in the Liaotung Peninsula and about two-thirds of the southern extension of the Chinese Eastern Railway, together with the coal and iron mining rights which went with this part of the railway. Russia also turned over to Japan the southern half of the island of Sakhalin with its important oil reserves, and agreed to give up attempts to penetrate into Korea and to withdraw her troops from Manchuria. The transfer of the Russian railway interests and the leasehold to Japan was made conditional on Chinese consent. This consent was secured by Japan in the treaty signed Dec. 22, 1905.

PORT SUDAN, the chief seaport of the Anglo-Egyptian Sudan, Africa. It is situated on the Red Sea between 19° 37' lat. and 37° 14' E. long. The harbor consists of natural channels and basins. The town is a rapidly growing port, dating from 1905 when the government chose it as a more suitable port than Suakin for the trade of the Nile Valley. A railway connects the town with Atbara Junction. Pop. 10,000. See SUDAN.

PORT TALBOT, a town in Glamorganshire, south Wales, situated near the mouth of the Avon in Swansea Bay, 170 mi. west of London. Commercially, it was early allied with the Cornish, who brought copper for smelting to the Aberavon Valley coal region. To accommodate modern traffic, the Avon has been deflected into an artificial channel, constantly under improvement. Since the World War, Port Talbot has been actively expanding along the coastal plain. The ancient copper, tin-smelting, and iron industries persist. Pop. 1931, 40,672.

PORT TOWNSEND, a port city in northwestern Washington, the county seat of Jefferson Co., situated on Port Townsend Bay, 38 mi. northwest of Seattle. Steamships, bus lines and two railroads serve the city. The harbor is considered one of the best in the world. The traffic for 1929 amounted to \$5,768,000. The

chief exports are lumber and paper with which the principal local industries are also concerned. The countryside affords diversified farming, and there are high-class dairy herds. The city is the seat of a U.S. Marine Hospital and the gateway to the Olympic Mountains. Fort Townsend was founded in 1851 and incorporated in 1852. Fort Townsend, built in 1856, was followed by three other garrisons, Worden, Casey and Flagler which guard the entrance to Puget Sound. Pop. 1920, 2,847; 1930, 3,979.

PORTUGAL, a republic on the western edge of the European continent, comprises part of the Iberian Peninsula, a parallelogram in shape bounded on the south and west by the Atlantic Ocean and on the north and east by Spain. Area about 35,490 sq. mi.; pop. 1931, 6,660,852. The adjacent islands, Madeira and the Azores, have an area of 1,237 sq. mi. and in 1931 had an estimated population of 415,000.

In the inhabitants, originally of Iberian and Celtic stock, the mixture of races is still very perceptible. In the south the Moorish type prevails, while the peasants of the northern mountains suggest a Germanic element. The important Portuguese colonies in Africa, India (Diu, Daman, and Goa), Timor in the East Indies, and Macao in China have an area of about 772,000 sq. mi., with 9,000,000 inhabitants.

Surface Features. The physical features of the western margin of the Iberian peninsula show clearly how Portugal has succeeded in maintaining its independence of Spain. Though it is true that the mountain terrace of northern Portugal, the Serra da Estrella, 6,540 ft., and the mountains of Algarve in the south are geographically continuations of the Spanish sierras, nevertheless, of the great rivers, the Douro, Tagus and Guadiana, which all flow through Portugal to the ocean, not one becomes navigable until it has passed the gorges and rapids on the Portuguese frontier; none becomes a real artery of trade until it has entered Portugal. The numerous harbors, the chief of which are Lisbon, Leixoes, Oporto and Setubal, and the far western situation of Portugal tended to promote voyages of discovery and commerce with foreign peoples.

Portugal is a country of widely differing surface features. On the coast the promontories of naked rock alternate with large dunes. The mountains of the north and the Serra da Estrella attain almost alpine altitudes. To the south, however, the surface flattens and becomes somewhat desolate in character. LISBON, with a population in 1930 of 587,334, vies in the beauty of its situation with the Italian port of Naples, and COIMBRA, pop. 1920, 20,841, the "Portuguese Athens," looks down upon the banks of the Mondego, celebrated in history and song. OPORTO, pop. 1930, 227,595, perches on the north bank of the Douro.

Flora. In vegetation Portugal is one of the richest lands in Europe, for the heat of the southern sun is tempered by sea breezes. Growing here are the agave, or century plant, and the opuntia of Mexico, the pine of the north and the eucalyptus of Australia, the

PORTUGAL

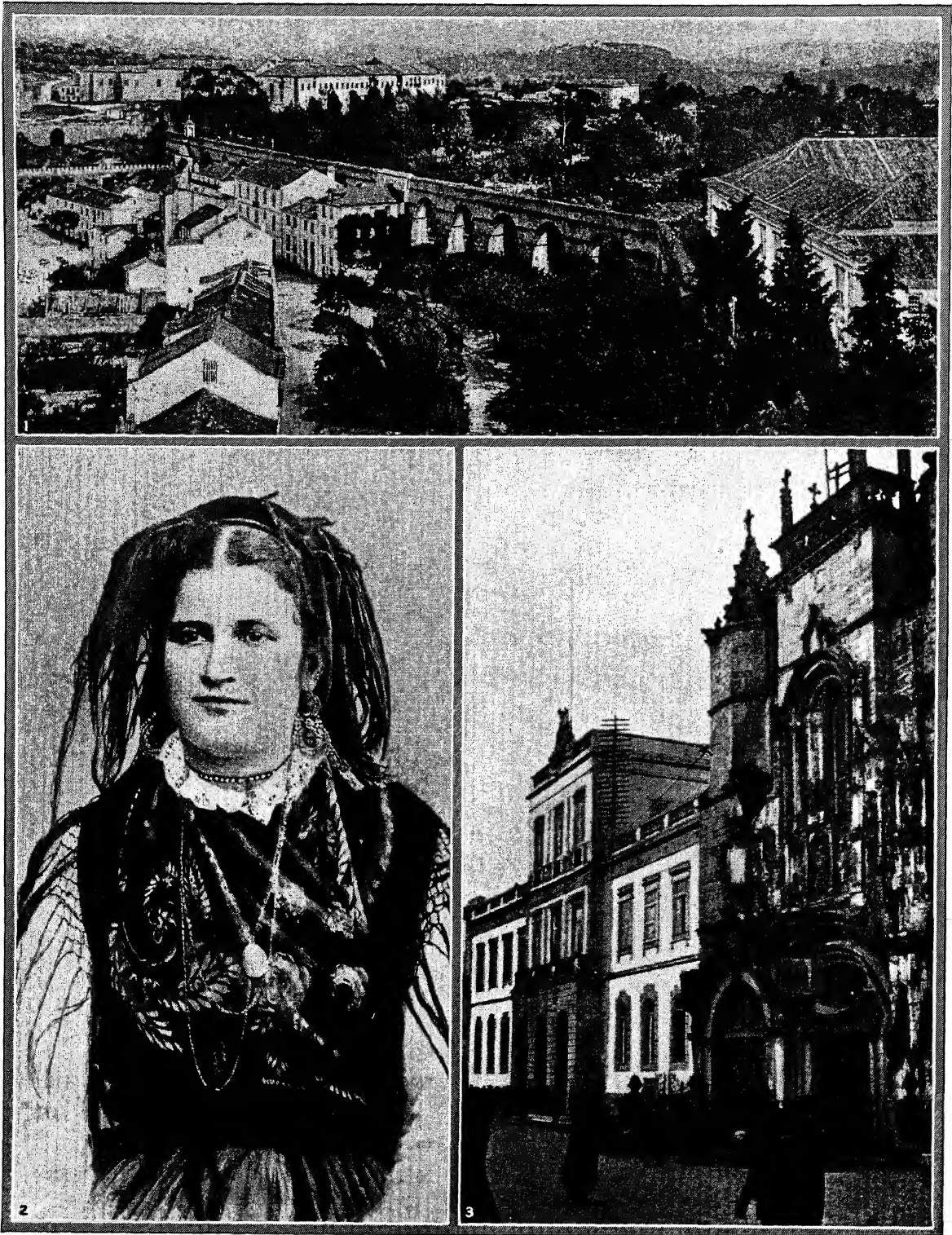


COURTESY CONSULATE GENERAL OF PORTUGAL

INLAND AND COASTAL TOWNS OF PORTUGAL

1. Palacio da Pena above Cintra, central Portugal, built to resemble a medieval fortress. 2. New Cathedral (1580) at Coimbra.
3. Nazareth, a Portuguese seaside resort. 4. Bathing tents at Nazareth. 5. The waterfront at Faro.

PORTUGAL



COURTESY CONSULATE GENERAL OF PORTUGAL

VIEWS FROM NORTHERN PORTUGAL

1. A general view of Coimbra, showing the old aqueduct and botanical gardens. 2. Costume and headdress worn on fête occasions by women peasants. 3. The 16th century Romanesque Church of Santa Cruz, and, at left, the City Hall, Coimbra.

camelia tree of Japan and the maple, the Juniper and the "Portuguese cypress" from the Azores, where it is now extinct; cork trees, evergreen oaks, palms, poplars, limes and magnolias all flourish alike. The indigenous flora is just as interesting, especially in the early spring, when the meadows unfold their full luxuriance and when the sides of the railway embankments are covered with sedum, honeysuckle and wild roses. Among the most characteristic features are the huge moors of cistus, the yellow flowers of which alternate with rosemary, myrtles and gaily colored bulbous plants. In the higher lying moors the characteristic variety is the gum-cistus. From the long evergreen leaves and from the large white flowers, each with a spot of dark purple within, oozes a sweet-smelling gum. Wheat, maize, millet, rye, lupin, oats and beans are cultivated throughout the whole country. There is scarcely a tree which does not produce some edible fruit, from the evergreen oak and the carob-tree to the olive, the almond, the vine, the orange and the fig. The variety of oranges known as Manderins is highly prized. The figs are brought to premature ripeness by "caprification" and have a most delicate flavor. The honey is famous. The sea is not behind the land in fruitfulness, and no fish-market in the world is richer than that of Lisbon.

Agriculture. Certain parts of Portugal show a high degree of cultivation. Such are the districts on the Minho and the Douro (Oporto), western Estramadura (Lisbon) and of late years the province of Alemtejo, once the granary of the country where the ancient wooden plough is seen beside the latest American agricultural machines. The greater part of the land however, is very poorly cultivated and now forms an immense pasture for sheep and pigs. The wheat grown frequently does not meet the demand and in 1925 269,497 tons were imported. Cattle raising and wine production are next in importance and the numerous cork oaks are a valuable asset. The fisheries occupy 50,000 men and the various mines employ more than 6,000.

Manufactures. Manufactures are unimportant from the point of view of international trade. The chief articles are textiles, preserves, metal, leather, cork, sugar, paper, glassware, china, earthenware, lace and filigree work. The imports were more than double the exports in 1926. The largest imports were raw materials and foodstuffs and the chief exports were also food products, including fruit and, above all, wine, which accounts for 50% of Portugal's exports.

Besides the navigable rivers and good harbors, Portugal had in 1927 over 2,000 miles of railroads.

Finance and Government. The Bank of Portugal has a small gold reserve against which it issues large sums of paper money. There are 21 other banks and 18 credit associations.

According to the revised constitution of 1919, Portugal became a democratic republic, with a president elected for five years by a Senate and Chamber of Deputies. These were suppressed in 1926 by a revolu-

tion instigated by the military leaders. Subsequently, General António Oscar de Fragoso Carmona, who became the dictator, was elected President in 1928.

PORTUGAL, HISTORY OF. Portugal's earliest history is inseparably connected with that of the entire Iberian peninsula, despite the fact that the later development of Portugal as one of the earliest national states was due to historical causes and accidents which differentiated the people of the southwestern end of Iberia from the rest, to such an extent that when Philip II attempted in 1580 to weld Portugal and Spain into one nation his efforts were unavailing. After the Celtic invaders of the peninsula had merged to form with the native Iberian (or Euskaldunac) people the five tribes mentioned by Strabo, the Greeks and Carthaginians established trading posts, chiefly at the mouths of the important rivers. There is in this connection a tradition that the present capital of Portugal, Lisbon, was from the earliest time associated with the wanderings of Ulysses, whose name is said to have clung to the City of Ulysses or Olisipio.

The Romans seized the southern provinces of Iberia from the Carthaginians after the second Punic War, and later the less civilized regions of the north and west, which are to be noted here only as affording a basis for the common identification of Portugal with the old province of Lusitania,—an error dating back to the end of the 15th century and reenforced by its general assumption during the Renaissance period. At that time the mistake was made well-nigh impregnable by the choice of title Camoens made for his sublime epic, "Os Lusíadas," or the Lusíads.

Until the Germanic invasions of the 5th century, the peninsula remained peaceful under Roman rule. The Alani and Suevi and Vandals found easy settlement among the Romanized inhabitants, but were shortly pressed across the isthmus into Africa by the Visigoths, whose influence was slight and whose power in turn declined as the Mohammedans began to take part in the struggle between the Visigothic nobility and the Christian Church, at the invitation of the latter. Three hundred years after the last king of the Visigoths had been killed in battle by the Moors, 711, Ferdinand I of Leon and Castile, 1037-65, reconquered the northern parts of what was shortly to become Portugal and his successor gave the county of Portucale (from Portus Cale, or Oporto, i.e., The Port) to Count Henry of Burgundy, together with his illegitimate daughter in marriage. It is therefore in 1095 that the separate history of Portugal proper begins.

Established as Kingdom. Throughout this formative period and for nearly four centuries to come, the compelling forces that alternately made or marred the success of national growth were the opposition of the Moors and the ambition of rival kings in Leon, Castile, or Galicia. It was after a brilliant victory over the Moors in 1139 that Count Henry's son, Alfonso Henriques, proclaimed himself king of Portugal, and the next 25 years of his reign were one long crusade against the infidels. During its course the

conquest of Lisbon in 1147 practically brought about the shift of the capital from Coimbra to the former city at the mouth of the Tagus. It was on this occasion that the presence of great numbers of Englishmen among the crusaders may be said to mark the beginning of close international cooperation between England and Portugal. This was strengthened in the reign of Alfonso IV, 1327-57, when free trade was established in the exchange of Portuguese wine for English long-cloth. The coming of the Black Death to Portugal in 1348 was a severe blow to the economic prosperity of the country, although a revival soon followed which prepared the way for the dominance of Portugal in the first century of the Age of Exploration.

Meanwhile, the Anglo-Portuguese alliance had been further cemented by the Treaty of Windsor, 1386, which accompanied the marriage of Don John the Bastard, founder of the house of Aviz, with Philippa, daughter of John of Gaunt. The assumption of the throne by Don John as John I, also called "the Great," marks the end of the stage of independence and consolidation, and ushers in the period of expansion overseas. Following the impulse given by Prince Henry the Navigator (1394-1460), general interest in the problems and profits of navigation and exploration was aroused, and resulted rapidly in commercial expansion, first to Madeira, the Azores, then the western coast of Africa to the gulf of Guinea, and south to the Cape of Good Hope by 1486, finally the Indies, reached by the sea-route in 1497. Bartholomew and Diniz Diaz, Vasco da Gama, Fernando Po, Pedro Escobar and Pedro Alvares Cabral, the discoverer of Brazil, were among the men encouraged by the Portuguese prince and later by his successor Alfonso V in the work of enhancing the power and prestige of Portugal.

At the Height of Power. By the end of the 15th century the establishment of Portugal as a great power was established, as it were, officially in the treaty of Tordesillas, 1494, concluded by John II of Portugal, and Ferdinand and Isabella, joint monarchs of Spain. The treaty ratified the bill of Alexander VI delimiting the possessions of the two nations by means of the famous demarcation line drawn along the meridian of longitude 370 leagues west of Cape Verde. Present and future establishments and conquests west of that line were to belong to Spain, those east, to Portugal. In 1510 Alfonso de Albuquerque made and ruled over important conquests in Hindustan and Indo-China. The reign of Emmanuel I, 1495-1521, surnamed "the Fortunate," marks the zenith of the power of Portugal. His reign saw the development of the national style of architecture, known as the "Emmanuel style," which flourished until about 1530, when Renaissance art was introduced. The royal Burgundian line became extinct in 1580 with the venerable Cardinal Henry, and Portugal was incorporated with Spain, with which it was obliged to share the results of the unfortunate struggle with the Netherlands. In 1640, however, the people placed the Duke of Braganza, descendant of a natural son of King John I, on

the throne as John IV. The new dynasty succeeded in maintaining the independence of Portugal against Spain, but the old glory was gone. The spendthrift policy of John V, 1705-50, impoverished the country in spite of the gold and diamond mines of Brazil. The famous Methuen Treaty, 1703, though doubtless it did much to insure the independent existence of Portugal, practically made it a commercial satellite of England.

In the 18th century the intelligent efforts of Pombal, one of the ablest statesmen of his century and the minister of Joseph I from 1756-77, led to reforms in the internal order and the foreign policy, but had no lasting effect, and under Joseph's daughter, Maria I, 1777-1816, who married her father's brother, Don Pedro III, the power was again appropriated by the nobles and the clergy. During the Napoleonic period, Portugal united with Great Britain in fighting for the independence of Spain, and it was the base of the military operations by which the French were finally expelled from the peninsula. The royal family had meanwhile retreated to Brazil in 1807 and, on their return in 1821, the king, John VI, 1816-26, was compelled to sign the liberal constitution which had been proclaimed in his absence by the provisional government. At the same time he ratified the independence of Brazil. After a long series of contests between the Miguelites and the Liberals, Portugal entered into a new era of comparative prosperity during the reign of Maria da Gloria, 1826-53, interrupted, however, by serious financial crises. Financial stability was not attained in the reigns of either Pedro V, 1853-61, or of Luis I, 1861-89. Liberal and conservative ministries followed one another in rapid succession, without being able to cope with either the economic or the political situation.

A partial national bankruptcy led in 1892 to differences with the great powers and finally in 1901 the management of the revenues was entrusted to a commission including representatives of Great Britain, Germany and France. The attempts of the king to wipe out the ingrained political corruption by a dictatorship of the able minister, Joao Franco, led to the assassination of King Carlos, 1889-1908, and his eldest son, by Republican conspirators Feb. 1, 1908. His second son, Manuel II, born 1889, succeeded to the throne and dismissed Franco, but was unable to stem the Republican tide. On Oct. 4, 1910, revolution broke out in Lisbon and the king took refuge in England. The religious orders were expelled, a constituent assembly was summoned and a Republic proclaimed on June 20, 1911, of which Manuel de Arriaga was elected president for a term of four years.

The Republic. Persuaded by Great Britain Portugal was obliged to participate in the World War on the side of the Allies, although some of the troops which had been mobilized refused to go to the front. President Guimaraes, 1915-19, and reelected 1925, was ousted in 1925 by Gomes da Costa, who was in turn driven from office in 1926 by Gen. Carmona. As provisional president and, since Apr. 15, 1928, as

elected president, Carmona suppressed local revolutions in Portugal, Madeira and the colonies.

At the present time, the Portuguese colonial possessions comprise Guinea, Angola and Mozambique in Africa, numerous scattered islands off India and Australia, Goa in India, Macao on the Chinese coast and the Azores, Madeiras, and Cape Verde Islands in the Atlantic Ocean. Their intrinsic value as a whole is not great, though it has been on the increase since the beginning of the 19th century. The population amounts to approximately 8,737,853 inhabitants for an area aggregating 937,500 sq. mi.

BIBLIOGRAPHY—J. Smith, *Memoirs of the Marquess of Pombal*, etc., 1843; E. MacMurdo, *History of Portugal*, 1889; R. Beazley, *Prince Henry the Navigator*, 1895; S. H. Morse, *Portugal*, 4th ed., 1908.

PORTUGUESE EAST AFRICA. See MOZAMBIQUE

PORTUGUESE GUINEA, a Portuguese territory on the west coast of Africa, extending from Cape Roxo in 12° 9' N. to Cogon Bay in 10° 50' N. lat., and entirely surrounded on the land side by French territories. The area of about 22,000 sq. mi. is chiefly savanna forest; it has a low, irregular coastline, off which is the volcanic Bijagoz archipelago. On one of these islands is Bolama, the capital. The chief port is Bissau, chiefly exporting palm kernels. Small quantities of palm oil, rubber, hides and beeswax are shipped. The country has been developed only slightly beyond the coastal region. Pop. 1928, 343,961.

PORTUGUESE LANGUAGE, a ROMANCE language spoken chiefly in Portugal by 5,600,000 people and in Brazil by 40,000,000, and connected with SPANISH through GALICIAN.

Portuguese appears in documents at the end of the 12th century and in literature two centuries later with lyric poetry inspired by Provençal troubadours. Its most characteristic feature is the abundance of nasalized vowels and diphthongs, as Latin *manu*^m = Portuguese *mão*, "hand," Latin *campu*^m = Portuguese *câpo*, "field." No Latin vowel is diphthongized, all Portuguese diphthongs (excepting *ou* = Latin *au*, as Portuguese *cousa*, "thing" = Latin *causa*) being due to palatalization or labialization, e.g., Latin *octo* = Portuguese *oito*, "eight," Latin *altru*^m = Portuguese *outro*, "other." An interesting survival of consciousness of the primitive formation of the Romance future is seen in the insertion of the personal pronoun between the stem and the termination, as *dir-te-hei*, "I shall tell thee," rather than *direi* (Vulgar Latin *dicere tibi habeo*; contrast French [*je*] *te dirai*).

H. F. M.

BIBLIOGRAPHY—J. Cornu, "Die portugiesische Sprache," in G. Grober, *Grundriss der romanischen Philologie*, 2nd ed., 1904; J. D'Almeida Nogueira, *Grammaire portugaise*, 1913; J. Nunes, *Compêndio de gramática histórica portuguesa*, 1919; L. Ey, *Portuguese Conversation-Grammar*, 1922.

PORTUGUESE MAN-OF-WAR, the popular name for coelenterate colonies (genus *Physalia*) which superficially resemble individual jellyfish. Actually a man-of-war is made up of numerous separate animals, of several different sorts, each of which has some

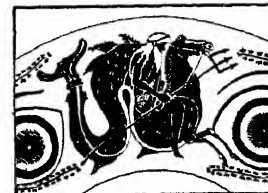
specific task to perform for the benefit of the whole assemblage. Some, the *gastrozooids*, have mouths. Their duty is to eat and digest food for the colony. Others, the *dactylozooids*, have fishing lines provided with powerful stinging cells which can paralyze and secure prey. These have serious effects even on man. Still others, the gonophores, produce sex cells to perpetuate the species. The first two types of individuals correspond to vegetative polyps, while the last are really jellyfish (*medusae*) which are never set free from the colony.

Men-of-war are familiar in tropical and subtropical regions of the Indian, Pacific and Atlantic oceans, and they are sometimes carried to Nova Scotia, and even to England by the Gulf stream. The colony has a large, somewhat pear-shaped, reddish or bluish float, about six inches long, from which stalks bearing the animals, together with the fishing lines, hang down like streamers. The float is ordinarily filled with gas and appears above the surface of the sea. Sometimes, however, the gas escapes, and the colony sinks. It can rise again in about 15 minutes, by making more gas. See also JELLYFISH.

A. I. W.

PORTULACA, a genus of low succulent herbs of the purslane family several of which are grown for ornament or as potherbs. There are about 20 species, known commonly as purslane, native chiefly to America, some 10 occurring in the United States. The diffuse or ascending stems bear flat or cylindrical leaves and in some species very showy flowers, of a wide range of colors. Of those grown for ornament the garden portulaca or sunplant (*P. grandiflora*), a native of South America with brightly colored flowers, is the best known. For the species grown as potherbs see PURSLANE.

POSEIDON OR NEPTUNE
MOUNTED ON THE MYTHOLOGICAL HIPPOCAMPUS



PORTUGUESE MAN-OF-WAR
(*Physalia physalis*) One-fifth
natural size

POSEIDON, the Roman Neptune, was god of the sea and son of the TITANS, CRONUS and RHEA. He was thus brother of ZEUS (Jupiter), of HERA (Juno), of HADES, HESTIA and DEMETER. By association with mortals and divinities of various ranks, he was parent of an innumerable family. Frequently he claimed influence over maritime cities, and he strongly favored

the Greeks in their warfare against Troy. His symbol was a trident or spear with three points, with which he could shatter rocks, control tempests and cause earthquakes. He was accompanied by dolphins. According to tradition, Poseidon and ATHENA disputed as to which should give the name to the capital of Attica. As patron of charioteers, Poseidon was honored at races. His palace was in the depth of the Aegean Sea, where he kept his horses with brazen hoofs and golden manes. When he drove over the waves they subsided at his advance.

POSEN, since the World War a part of the Republic of Poland, was a part of Prussia from the days of the partitions in the 18th century up to 1918. It has always been a territorial unit, fertile, well-watered, with good roads and excellent canals. Today it is the most progressive part of Poland, with the least illiteracy. For a brief period during the ascendancy of Napoleon, Posen was lost to Prussia, but regained in 1815. Prussia's attitude toward her Polish subjects was tolerant and conciliatory on the whole until 1848, despite her efforts to settle German colonists on the soil and replace the Polish language with the German. But after the revolutionary upheaval of 1848 and particularly after the founding of the German Empire, the Prussian attitude became harsh and repressive. The height of the coercion was reached in the years before the World War; but despite strenuous efforts the Prussian Government failed both in dispossessing the native Polish proprietors from their land and in replacing Polish by German in the schools and in the administrative system. Against all German efforts the highly organized Polish resistance of the old nobility, the new middle classes and the prosperous peasantry, organized in cooperative societies, proved effective. Since the formation of the Republic of Poland, Posen has slowly cemented its ties with its compatriots in the other provinces.

BIBLIOGRAPHY.—R. Dybowski, *Outlines of Polish History*, 1925; *Poland Old and New*, 1926

POSEN or **POZNAN**, capital of the Polish voievodship of the same name, situated on the navigable Warta, tributary to the Oder, 185 mi. west of Warsaw. In the 10th and 11th centuries Posen was the capital of Poland. The town possesses a number of monuments which are a record of its famous past and the eminent part which it played in the history of Poland, including the beautiful Renaissance 16th century town hall with a high tower, and a 10th century cathedral. There are the tombs of the two earliest Polish rulers, Mieszko I and Boleslas Chrobry. Among the Baroque churches the parish church, built in 1700, is distinguished by its beautiful interior. Posen possesses rich museums, of which the largest is the Wielkopolskie Museum. The city is the seat of the Archbishop of Posen and Gniezno and of a university. Large exposition buildings are erected near the railway station, in which the Posen Fair is held annually. Owing to the agricultural character of the voievodship the chief manufactures consist of agri-

cultural implements. Machines, locomotives, airplanes, clothing, tobacco products, chemicals, leather belting, food products and beverages are also produced. The trade is chiefly in grain, potatoes, lumber and fertilizers. Est. pop. 1930, 248,000.

POSITIVE RAYS, the streams of positive IONS which flow toward the CATHODE in a discharge tube (see TUBES, ELECTRONIC). These rays, also called canal rays, become conspicuous in their effects when the discharge tube has been exhausted to a pressure of one-millionth of an atmosphere and yields a plentiful supply of CATHODE RAYS. In such a vacuum, the cathode rays, consisting of high velocity ELECTRONS, stream through the residual gas away from the cathode, and the canal rays move toward it. If a hole is made in the negative electrode plate, the cathode, some of the positive rays will pass through it into the space beyond. Compared with the electrons which make up the cathode rays, the moving bodies in the positive rays are of large mass and possess relatively low velocities. They are, in fact, positive ions produced by the splitting up of ATOMS or MOLECULES of residual gas (see IONIZATION). Positive rays are deflected in crossing magnetic or electrostatic fields and they produce visible radiation in the residual gas of a color different from that produced by the cathode rays.

The cathode rays are believed to result from the bombardment of the cathode by the positive rays. It is well known that the cathode rays are produced in profusion only when the gas pressure has been reduced to a very low value, and that at extremely low pressures the cathode discharge ceases altogether. These observed effects are accounted for in the following manner. At low gas pressures, because of their greater freedom of motion, the positive ions acquire velocities sufficiently high to enable them, when they strike the cathode, to knock out some of its excess electrons. The electrons freed in this manner stream away from the cathode at enormous speed and constitute the cathode rays. But at excessively low gas pressures, the molecules of the residual gas are so widely separated that very few positive ions are present, and ionizing collisions are rare. Hence, at very low gas pressures, the bombarding action at the cathode is diminished, and few, if any, electrons are released.

L. B. S.

POSITIVISM, a philosophic movement closely associated with the name of AUGUSTE COMTE (1789-1857), its leader and chief expounder. The key to this system is the famous law of the three stages through which all thought must travel. History shows that thought has passed from the theological through the metaphysical to the positive stage. The theological is characterized by anthropomorphism, which sees nature as governed by volitions similar to our own; the metaphysical by a conception of nature in terms of forces and occult essences; the positive by a view of nature as merely an assemblage of things and events, the connections between which need only to be established. The positive attitude is thus scientific; it seeks to determine the connections

between things without troubling itself with their underlying causes. The sciences so conceived may be classified according to their degree of positivity, i.e., the degree to which they embody the positive attitude. Arranged in a hierarchy of decreasing generality and increasing complexity, or the principles by which positivity may be concretely determined, the sciences may be classified as follows: mathematics, astronomy, physics, chemistry, biology, including psychology, and sociology. Sociology was considered the least positive of the sciences, but Comte looked for a day when the positive régime might be set up even in this province.

POSSESSION, in law, the continuing exercise of a claim to the exclusive use of some material thing. Who is in possession is a question of fact, who is owner is a question of law. An owner may have a right of possession and yet not be in possession. One who is in possession will be protected in that possession against every one except some one who has a statutory right of possession. Thus while possession and ownership commonly go together, they may be, and frequently are, separated. One of the ways of acquiring title to ownerless things, such, for example, as wild game or fish, is by taking possession. Also possession is important in such cases as levy of execution and levy of attachments where rights are acquired by taking possession under the writ. In the case of vacant and unoccupied lands while no one is in actual possession, the owner is said to be in constructive possession so as to enable him to bring possessory actions against trespassers.

POST, GEORGE BROWNE (1837-1913), American architect, was born in New York City, Dec. 15, 1837. After graduating from New York University he studied architecture under RICHARD MORRIS HUNT. He fought in the Union Army throughout the Civil War, and immediately afterward opened an office in New York City. He was architect of the New York Stock and Produce Exchanges, the Pulitzer Building, the College of the City of New York, the Wisconsin State Capitol, and many other noteworthy structures; and he was one of the group responsible for the rapid development of American architecture in the last quarter of the 19th century. Mr. Post was made a member of the French Legion of Honor in 1901. He died at Bernardsville, N.J., Nov. 28, 1913.

POSTAL CLERK, one who is occupied in receiving and distributing mail. A postal clerk is generally that member of the postal service stationed in post-offices to dispatch mail received from the public, but the term applies as well to the money-order clerk, distributor, forwarding and directing clerk, railway mail clerk and the "hard reader," or one who deciphers illegible handwritings. A postal clerk must be a United States citizen, possess certain age and physical qualifications and pass a Civil Service examination. See also POST OFFICE DEPARTMENT.

POSTAL SAVINGS SYSTEM, UNITED STATES. Since 1910, the Federal Government has maintained postal savings depository offices under the

supervision of the postmaster general, the secretary of the treasury and the attorney general. Accounts may be opened for as little as \$1 by persons over ten years of age, and individual balances may not exceed \$2,500. Interest is credited annually at the rate of 2%. Deposits may be exchanged for 2½% postal savings bonds in denominations of \$20, \$100 and \$500. There is no restriction as to the amount of bonds which may be held. Backed by the credit of the United States Government, postal savings depositories are intended to encourage thrift and offer banking facilities to timid investors in times of financial stress. The following table shows the growth of the postal savings system:

Year	No of Offices	Balance due Depositors	No of Depositors	Average Balance Per Depositor
1911	400	\$ 677,145	11,918	\$ 56 82
1921	5,554	158,389,903	466,109	326 94
1930	6,795	175,371,686	466,401	375 80

The states with the largest volume of postal savings deposits on June 30, 1930 were New York, with \$26,500,238, Florida, with \$16,489,291 and Illinois, with \$9,468,318.

POSTERS, or placards placed in public places for various advertising purposes, go back to the dawn of civilization. Stones which presented certain decrees to the populace in ancient Babylon were a perfect example of posters. Publicity in the form of mural paintings was common practice in Egypt and Assyria. The painted shop fronts of Pompeii and the lifelike reliefs on the Column of Trajan in Rome were all forerunners of the modern poster.

Jules Cheret, born in 1836, is the creator of the modern art poster. Stunned by the sight of a garish circus billboard advertisement in 1867, he was inspired to produce the famous poster advertising Sarah Bernhardt in *La Biche au Bois*. He was immediately a success and his posters became so much the rage of Paris that a contemporary magazine observed that "it is difficult to conceive of Paris without its Cherets." There are no subtle harmonies in the work of Cheret. His posters are a riot of color and convey a spirit of hectic gayety. Other important figures in the early French school of poster design were Grasser, Metivet, Willette and Forain and Steinlen of Switzerland.

In Germany the work of Ludwig Hohlwein showed a striking originality which obtained for him an international reputation. Franz von Stuck, Hoffman and Otto Fischer were among other leading German poster designers.

The first English posters were more concerned with art than advertising as illustrated by Frederick Walker's *Woman in White* drawn in 1871 for the dramatized version of Wilkie Collins's novel of the same name. The manufacturers of Pear's soap created a sensation by acquiring Sir John Millais's *Bubbles* for advertising purposes. AUBREY BEARDSLEY did interesting poster work in brown and white in the 90's. Other prominent English designers were Frank Bragwyn, the Beggartstaff brothers (James Pryde

and William Nicholson), Bernard Partridge and Gordon Craig. The London Underground was responsible for the development of the modern British school represented by Herrick, Gladys Peto, Aubrey Hammond and E. McKnight Kauffer. Contemporary railway posters of Germany, France, Italy, England and Switzerland are often true works of art.

Louis J. Rhead's *White Rabbit* poster for *Harper's* in 1890 is probably the first authentic poster produced in the United States. This was closely followed by the equally famous advertisement for Pearlina Washing Powder, showing a girl in a red and green dress pinning a huge white sheet on a clothes-line. The bicycle industry was quick to adopt artistic posters. MAXFIELD PARRISH, HOWARD CHANDLER CHRISTY, James Montgomery Flagg and J. C. Leyendecker are prominent names in American poster art. During the World War the best poster talent of all countries was called upon to aid in the furtherance of public conservation of food, subscriptions to the Red Cross and the promotion of various activities. While American posters are in no way inferior to European it cannot be denied that contemporary Russian, French and German work outstrips that of other nations in novelty and daring. See ADVERTISING ART.

POST-IMPRESSIONISM, after an exhibition in England in 1911, a term applied to a movement in modern French painting, reactionary against IMPRESSIONISM. The reaction had taken place a number of years earlier, and Cézanne, Van Gogh and Gauguin, whose works were seen in the exhibition, were all dead by 1911. To the names of these leaders of the movement must be added that of Georges Seurat. All were trained in the methods of Impressionism, but here their similarity ended. By 1890 they had broken away from Impressionist canons.

The Impressionists, in their preoccupation with the effects of lighting, of the fugitive aspects of nature and atmosphere, had lost interest in form, composition and any deeper values than the transitory effects they sought to fix on their canvases. Their art was essentially an objective and unintellectual one. Rebelling against these limitations, the Post-Impressionists asserted the artistic validity of the painter's emotional reaction to his subject, and of his search to penetrate the surface of the subject in quest of its fundamental significance. The Post-Impressionists also upheld the right of the artist to translate his esthetic experience into paint through whatever methods he found most effective.

Seurat, an intellectual, was a master of composition. He went back to Ingres and Delacroix for drawing and color, respectively. He was the first to build his art on the classical idea of architecture as the basis of art. Cézanne did this later. Both these men were fundamentally classic, in that they relied on a formal and harmonious arrangement of objects to rouse emotion, in contradistinction to the Romantic method of leaning for effect upon the objects depicted. This classicism has had an enormous influence upon modern art. Cézanne also brought back

depth, weight and solidity to painting, and sought to portray the dynamic side of nature. His arrangement of color in numberless planes is responsible for the feeling of depth in his work.

Gauguin, like Cézanne and Seurat, began his career as an Impressionist. His study of Japanese art and the Primitives led him to another kind of space-composition, however, and he revolted from the complications in the art and life of France for the simplicity of life in the tropics. His sense of pattern and rich color harmonies are far removed from Impressionism. The same is true of Van Gogh. He also spent a portion of his career as an Impressionist, but the fierceness and passion of his art, often described as lyric, soon found Impressionism inadequate for its needs. The soft contours and luminous haze of the latter movement are far removed from Van Gogh's bold applications of flaming color.

BIBLIOGRAPHY.—Chassé, *Gauguin*, Colin, *Van Gogh*, 1926, Fry, *Cézanne, A Study of His Development*, 1927.

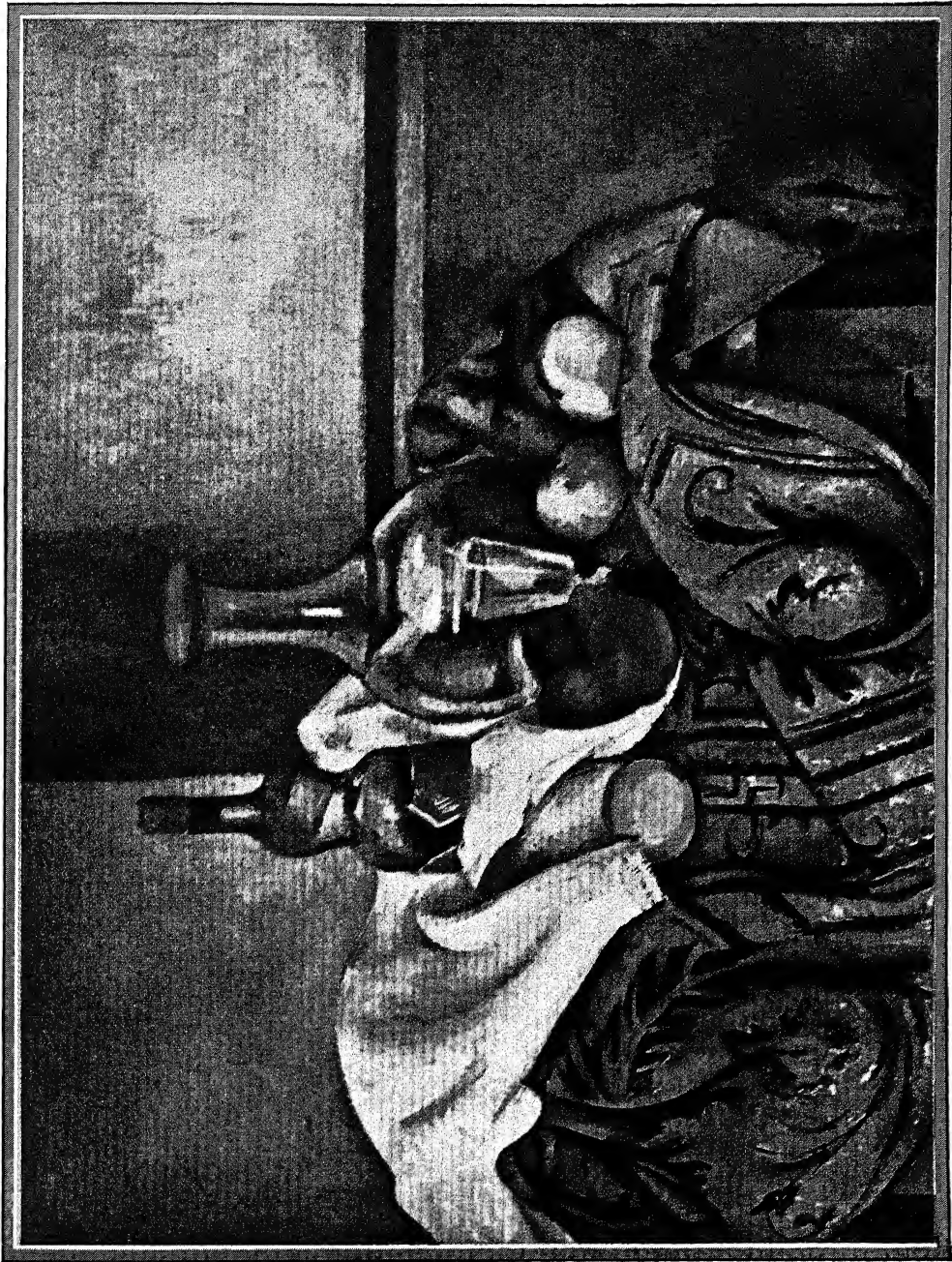
POST-OFFICE DEPARTMENT, a governmental department headed by the Postmaster-General, which conducts the postal service of the United States. The Postmaster-General appoints all his officers and employees except the four assistant postmasters-general, the purchasing agent, comptroller, and postmasters of the first, second and third classes, whom the President appoints. The large patronage thus attached to the position of Postmaster-General makes it important as a channel for reward of political services. With the President's approval, the Postmaster-General makes postal treaties with foreign countries. He contracts for air and ocean mail services, and is the executive head of the Postal Savings. Among the assistants to the Postmaster-General is divided much of the work of the Department: salary adjustments, mail service, dead letters, mail-transportation arrangements, money-orders, stamps and parcel post, selection of post-office quarters, engineering and research. The Solicitor of the Post-Office Department gives opinions and legal assistance upon matters arising in the course of business. An Inspector has jurisdiction over violations of the postal laws and charges brought against postal employees. S. C. W.

BIBLIOGRAPHY.—*Report of the Post Office Department*, 1931, *Congressional Directory*, 1931.

POSTULATE, any statement assumed as a basis for reasoning. In geometry one of the postulates is that a straight line can be drawn from one given point to another, although such a construction is purely imaginative. See GEOMETRY.

POTASH, the name commonly given to the substance which is chemically described as potassium carbonate, the term caustic potash generally being reserved for potassium hydroxide or potassium hydrate. Potash derives its name from the fact that in former days it was made exclusively from the ashes of burnt land plants, which were dissolved in water, the solution then subsequently being concentrated and evaporated in iron pots. The resulting potash contains many impurities such as potassium sulphate, and

POST-IMPRESSIONISM



"GRANDE NATURE MORTE"

A still life by Paul Cézanne (1839-1906), in the Chester Dale Collection, New York.

chloride, silicates, and various organic substances, but the mass may be refined and again crystallize out the potash, now relatively pure, and known commercially as "pearl ashes." Nowadays potash is made mostly from the Stassfurt kali-deposits and limestone, by means of a slightly modified Leblanc process, similar to that used for the manufacture of SODA. Since carbonic acid is a very weak acid, a watery solution of potash hydrolyzes and has a strong alkaline reaction, on which are based most of its applications in the laboratory.

Industrially potash is used in the manufacture of flint glass and for making soft SOAPS, though in the latter process it is now almost invariably replaced by caustic potash or potassium hydroxide, made from the carbonate or other potassium salts by electrolytic methods. The aqueous solution of the hydroxide is evaporated in iron or nickel pans until it becomes so strong that it would corrode them, when it is further concentrated in silver or gold vessels, finally fused and poured into iron moulds, to form the well-known sticks, or poured in slabs and later marketed as flakes. Caustic potash is avidly soluble in water and one of the strongest alkaline substances known; it attacks glass to the extent of dissolving the lead out of it, and destroys and dissolves the skin for which reason it is sometimes used to treat warts and similar growths. *See also* FERTILIZERS. W. J. L.

POTASSIUM, a metallic element belonging to the group of the alkalis, from which are derived its other name kalium, and its chemical symbol K; its atomic weight is 39.10. In the pure state it is soft and glistening white in appearance, but tarnishes immediately in air, and reacts with almost explosive violence with water, bursting into flame at once. It is, therefore, never found free in nature, but occurs widely distributed in a large variety of salts and combinations, being present in all plants and animals, in a number of minerals, and in the salt of the sea, the total potassium content of which, mostly potassium sulphate, is estimated at not less than a trillion tons. Formerly potassium salts were obtained chiefly from the ashes of land plants which, upon extraction yielded a solution of potassium carbonate or POTASH, but this has now largely been supplanted by the mineral supply of mixed potassium salts discovered near Stassfurt, Germany. Apart from the carbonate already mentioned, and the hydroxide known as caustic potash, the most important compounds are the nitrate, or saltpeter, occurring as a mineral, and formerly used for gun powder, the bromide and iodide, used in photography and medicine, the chlorate and permanganate, both strong oxidizing agents, the latter deep purple in solution and used as a remedy against snake bites.

POTASSIUM CARBONATE. *See* POTASH.

POTASSIUM HYDROXIDE. *See* POTASH.

POTASSIUM SALTS IN MEDICINE. The presence of potassium is essential to body functions, and in the form of salts it is widely distributed through the body. Compounds of potassium depress

the functioning of the nerves, heart, and skeletal muscles; on the other hand, smooth muscles are stimulated by the presence of potassium salts. The medicinal actions of potassium salts, however, are attributed mainly to their other components, and are practically equivalent to the corresponding sodium salts.

Among potassium salts used in medicine are:

Potassium acetate ($KC_2H_3O_2$), an alkaline diuretic used to increase the output of urine in certain forms of nephritis and to render urine less irritant in inflammation of the bladder. It also is oxidized in the body to potassium carbonate or bicarbonate, thus increasing the alkaline reserve of the body for overcoming acidosis.

Potassium bicarbonate ($KHCO_3$), colorless, transparent crystals, which are given in medicine to secure the same general alkaline effects for which the acetate or citrate of potassium are administered. On the whole, sodium bicarbonate is considered preferable to the use of potassium bicarbonate.

Potassium bitartrate ($KHC_4H_4O_6$), or potassium acid tartrate, known under the popular name of cream of tartar. Occurs as colorless or slightly opaque, rhombic crystals, or as white powder, slightly soluble in water. It is a common ingredient in certain baking powders. Medicinally it is used as a diuretic, and a mixture of it, or tartaric acid, with sodium bicarbonate and sodium potassium tartrate is known as Seidlitz powder. When mixed with water, copious effervescence takes place, forming a solution of sodium potassium tartrate (Rochelle salts), which acts as a laxative or cathartic.

Potassium bromide (KBr), white crystals or granular powder, having a strong saline taste; used as a nerve sedative, the same as sodium bromide.

Potassium chlorate ($KClO_3$), colorless crystals or white granular powder, soluble in water. It is explosive when mixed with oxidizable material and severe accidents have been caused by careless handling of the substance, particularly by "amateur chemists." In medicine it is used as a mouth wash in various forms of mouth infection, and as a flavoring in dentifrices, large doses have been the cause of

Potassium citrate ($K_3C_6H_5O_7$), transparent, prismatic crystals or white granular powder, very soluble in water. The action of potassium citrate is much like that of potassium acetate.

Potassium permanganate ($KMnO_4$), occurs as a dark purple in almost opaque prisms; odorless and having an astringent taste. Because of the marked oxidizing properties of potassium permanganate, it is used for destruction of certain poisons while still in the stomach, but is of little value if much organic matter is present. It is also used as a deodorant, germicide, and astringent. P. N. L.

POTATO, a fleshy herbaceous plant (*Solanum tuberosum*) of the nightshade family. It is grown widely in all temperate regions for its starchy, edible tubers used as an article of diet by a greater proportion of the world's population than any other food except rice. The plant, a native of elevated valleys

in the Andes, was widely grown by the native peoples from Chile to Ecuador at the time of the Spanish Conquest in the first half of the 16th century. It was brought into Europe about 1580-85, first by the Spaniards and then by the English at the time of Sir Walter Raleigh's visits to Virginia. Some authorities credit the introduction of the potato into England to Sir Francis Drake in 1586. The earliest published illustration of the plant is found in Gerard's *Herbal* (2nd. ed., 1599). It was not until about 1750 that the cultivation of the potato attained real importance in Europe outside of Ireland. About 1755 the potato began to be commonly grown in Germany. Since that period it has risen to front rank among economic plants standing second only to Indian corn as the most important American contribution to the world's food plants. The total crop is enormous, greatly surpassing in bulk the world crop of wheat or corn. Germany, Russia, France, the United States and Great Britain are the chief producing countries. In the United States the potato is cultivated to some extent in all the states and even in Alaska. See also SOLANUM.

Cultivation. Though cultivated potatoes resemble their wild progenitors, they show remarkable improvement in size, quality and productivity. These qualities are due partly to cultivation but mainly to the origination of new varieties by breeding and selection. The tubers on individual wild plants are few and rarely two inches in diameter whereas those on well grown modern plants often exceed six by two inches and weigh two to three pounds to the plant. The average yield of potatoes in the United States is less than 100 bushels to the acre. But favorable soil and climatic conditions coupled with good cultural methods often produce yields of 200 to 400 bushels to the acre.

POTATO PRODUCTION, U.S.

4-Year Average, 1927-30

Division	Acreage	Production (1,000 Bu.)	% of Tot. Prod.
UNITED STATES	3,511,000	397,058	100.0
LEADING STATES:			
Maine	177,000	43,103	10.9
Minnesota	327,000	30,197	7.6
New York	269,000	28,738	7.2
Pennsylvania	234,000	26,822	6.8
Wisconsin	251,000	23,547	5.9
Michigan	280,000	23,475	5.9

Potatoes thrive best in well-drained but moist sandy loam rich in humus. The seed tubers are cut in pieces containing at least one eye, but not more than three eyes each, together with enough of the tuber to give a good start to the young plant that develops from each eye. These pieces are planted by hand or machines from four to six inches deep, cleanly cultivated, sprayed frequently to prevent damage by insects and diseases and harvested and sorted after the tops have died.

M. G. K.

POTATO BEETLE, a destructive leaf beetle of the family *Chrysomelidae*. The original food of this insect is the sand-bur (*Solanum rostratum*) of the

Rocky Mountain region. About 1859 it shifted to the cultivated potatoes of settlers and has since spread all over the continent wherever this crop is grown. The black striped adults emerge in spring and for several weeks lay yellow eggs in clusters on the under sides of leaves. The livid-reddish larvæ eat ravenously and reach maturity in about a month, pupate in the ground and produce a second brood which hibernates in the ground. Poisoning with arsenates sprayed on the undersides of the foliage is the best remedy.

POTATO DIGGERS, machines for harvesting potatoes. The walking type of potato digger resembles an ordinary walking plow with rods substituted for the moldboards. An improved type has a large rounded scoop which slides under the potatoes and delivers them, with the soil, to a shaking grate operated by a five-pointed wheel. In the standard type riding digger the potatoes, soil and vines are scooped up by a shovel and delivered to an elevator comprising an open carrier chain. The elevator is agitated by elongated sprockets to sift out the soil; the potatoes and vines are carried to a vine turner which deflects the vines and permits the potatoes to fall upon the ground uncovered.

POTATO-TREE (*Solanum verbascifolium*), a woody plant of the nightshade family closely related to the potato, sparingly grown for ornament in the far South. It is found in tropical America, extending northward to southern Florida, and also occurs in the Old World tropics. The shrub grows usually from 6 to 20 ft. high with spreading, white, woolly branches forming a flat-topped head. It bears velvety, woolly leaves, sometimes 10 in. long, small white flowers in dense clusters, and round yellowish berries.

POTAWATOMI, a tribe of North American Indians who were living in the upper Green Bay region in Wisconsin when first encountered. They speak a dialect of the Algonkian linguistic stock and, according to tribal traditions, the Potawatomi, Chippewa and Ottawa were originally one Algonkian body which came in its westward movement from the region north or northeast of the Great Lakes and Mackinaw. When removed beyond the Mississippi in 1846, members of these three tribes asked to be again united. In their prime the Potawatomi probably numbered 3,000. They actively sided with the French until the treaty of 1763; took a prominent part in the uprising under Pontiac in 1763-65; sided with the English against the Colonists in the Revolution, and again with the English in the War of 1812. Toward the white men and particularly toward the advances of the Christian missionaries their friendliness was remarkable. They were originally worshippers of the sun, offering occasional sacrifices for the recovery of the sick or to obtain some particular desire. Special or individual manitos were chosen at the Feast of Dreams. Polygamy was common among the Potawatomi.

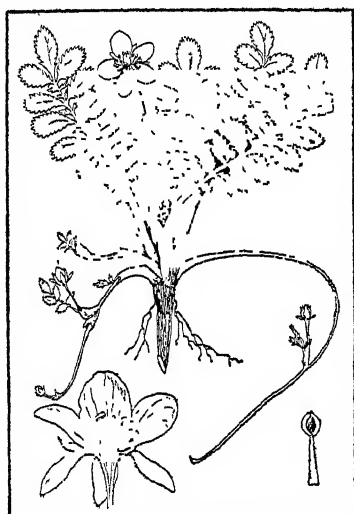
POTENTIAL, ELECTRIC, or voltage, the electrical pressure acting upon a circuit to "force" the

current through it. The potential of an ELECTRIC GENERATOR is proportional to the number of magnetic lines of flux cut per second by the conductors of the armature; 10^8 lines cut per second produce one volt.

The *potential drop* between two parts of a direct current circuit, in volts, is a product of the RESISTANCE, in ohms, between the two parts and the current, in amperes, flowing in the circuit; i.e., $E = IR$. See also ELECTRICITY.

POTENTIAL ENERGY. See ENERGY.

POTENTILLA, a numerous genus of herbs or sometimes shrubs of the rose family commonly known as cinquefoil or five-fingers. There are upwards of 200 species, natives chiefly of the north temperate and arctic regions; more than 100 occur in the United States. They are mostly annual or perennial herbs, often with creeping stems rooting at the



FROM JEPSON, MAN. FL. PLANTS CALIF. COPYRIGHT

SILVER CINQUEFOIL OR SILVERWEED
(*Potentilla Anserina*). A handsome plant
found widely in the northern hemisphere.
Above, whole plant Below, flower and
single stamen

joints (nodes), bearing pinnately or palmately divided leaves, in some species closely resembling those of the strawberry; solitary or clustered, yellow, white, or reddish flowers, and small achenes produced on a dry receptacle. Several species with brilliant flowers are grown for ornament, especially the shrubby cinquefoil (*P. fruticosa*), found in many forms throughout the north temperate zone.

POTENTIOMETER, an arrangement of instruments with which the magnitude of an unknown potential difference can be measured by comparing it with the known electromotive force of a standard cell. Its principal application is in the calibration of electric instruments and in laboratory investigations.

The Poggendorf method is the basis of the various potentiometers now used. In its simplest form, this method makes use of two variable, calibrated resistors connected in series and across the source of unknown potential difference. A series circuit, consisting of a GALVANOMETER with protective shunt and an auxiliary

BATTERY of known electromotive force, is connected across one of the two resistors, with the polarity of the auxiliary battery such that it opposes the flow of current which would otherwise flow in the galvanometer. The two resistors are adjusted until the deflection of the galvanometer is zero, and under these conditions it can be shown that the value of the unknown voltage is equal to the value of the known voltage multiplied by the sum of the two resistances and divided by the resistance across which the galvanometer is connected.

One of the chief difficulties in using the Poggendorf circuit in the above form is that the usual standard CELL used as the known voltage is unable to stand a current drain for any length of time. Therefore, to protect the cell it is necessary to use it only intermittently, making the resistor adjustments between readings of the galvanometer.

In the various commercial potentiometers, the measuring current of the device is supplied by a battery capable of rendering continuous service, and is adjusted to its correct value by means of an auxiliary circuit containing the standard cell. The device is arranged so that this preliminary adjustment can be made rapidly, keeping the standard cell in the circuit only a short time.

Having thus set up a known current through the resistors in the instrument, the potential difference across these resistors can be used as a standard of comparison in a manner similar to that used in the Poggendorf method. No computation is necessary to obtain the result since the various dials of the apparatus are usually marked in volts.

Potentiometers are usually designed for the measurement of potentials of only a few volts. For measuring higher voltages, it is necessary to use some kind of voltage-dividing device. Usually a *volt box* is used, this device consisting of a high-resistance winding tapped at known fractions of the total resistance so that a small part of the total voltage can be supplied to the potentiometer for measurement.

Potentiometers are also useful in the measurement of electric current and the calibration of AMMETERS and WATTMETERS. The unknown current is passed through a standard resistance and the voltage across the resistance is measured by the potentiometer. The current is then computed directly as the ratio of voltage to resistance. In wattmeter calibration, two potentiometers are used, one to measure the voltage across the potential circuit and the other to measure that across the resistance. The product of the current and the circuit potential is the true power which the wattmeter should indicate.

The Tinsley-Drysdale potentiometer is a type designed for measurements of either direct or alternating voltages. By it, both the magnitude and PHASE angle of an alternating voltage (see ALTERNATING CURRENT) may be measured.

Several types of standard cells are available for use with potentiometers. Because of its reproducibility and permanence the Weston normal standard cell is

commonly used. It is supplied in a convenient portable form suitable for general laboratory work. Although each cell is individually calibrated, they average very close to an electromotive force of 1.0186 volts. The usual potentiometer circuits provide means for compensating for any small departures from this value.

W. H. T.

POTENZA a city of Italy, capital of the province of the same name. It is situated in southern Italy, on an eminence on the bank of the Basento River, and on the railroad between Naples and Metaponto. It is the seat of a bishop, a prefect and has several interesting churches, advanced technical and vocational schools, encircling walls and former fortifications. The chief occupation is trade in agricultural products. It is built on the site of the ancient Potentia, at the crossing of the Via Herculia with a road connecting with the Via Popillia and the Via Appia. The city has suffered greatly from earthquakes, particularly in 1857. Pop. 1931, 25,433.

POT-HOLES, smoothly polished, kettle-shaped cavities worn in bedrock by the grinding action of pebbles or boulders kept swirling in strong stream eddies, at the foot of waterfalls, or in "mills" under glaciers. Glacial potholes are often of immense size. Potholes formed or forming in swift eddying streams range in diameter from three inches to 10 ft. and are rarely more than 8 ft. deep. When numerous and deep, they may be important factors in erosion. Pothole work is strikingly exemplified in the scalloped channel of Watkins Glen, near Ithaca, New York. Glacial potholes of great depth occur in Wisconsin Interstate Park.

POTLATCH, a lavish feast accompanied by the free-handed distribution of valuable presents. The custom of potlatch is characteristic of the American Indians of the northwestern coast from Oregon to Alaska, and particularly of the Kwakiutl and Tlingit tribes. A potlatch is given for the purpose of gaining prestige or of ruining a rival. Such a feast must always be returned within a given time in a manner which exceeds the original feast in quantity and extravagance of the food served and in number and value of gifts distributed. In the event that the feast is not returned the recipient is degraded socially and politically. In addition to the gifts much property such as blankets, canoes and the like is sometimes burned or otherwise destroyed. This must also be copied and exceeded at the reciprocal feast. Occasionally a potlatch is given to a tribe by a wealthy member solely as an evidence of his greatness and prestige.

POT MARIGOLD (*Calendula officinalis*), a hardy annual of the composite family with showy orange-colored blossoms. It is a native of Europe long and widely cultivated in flower gardens. The branching stems, 1 to 2 ft. high, bear oblong clasping leaves and solitary flower-heads composed of numerous spreading rays, which close at night. The pot marigold is of easy culture, usually blossoming in gardens during the whole season; it is also much grown in pots under glass for winter bloom. See CALENDULA; MARIGOLD.

POTOMAC COMPANY, an enterprise, in which George Washington was prominent, for improving the navigability of the Potomac. The announced purposes were diversion of the trade of western Pennsylvania and the Ohio valley to the marts of Maryland and Virginia, and advancement of "the political interests of the United States by forming a free and easy communication with the people settled on the western waters;" an increase in land values in the Ohio valley was also contemplated, to the profit of Washington and others interested. Letters from Washington to prominent Virginians brought the project before the Virginia legislature in 1784; the concurrent action of Maryland was obtained; in 1785 identical laws passed by both legislatures created the Potomac Co. The removal of obstruction, the construction of canals and locks on the Potomac were planned; and each state voted an identical sum for the opening and maintenance of a road from the point of highest navigation on the Potomac to the Cheat River or the Monongahela, as commissioners should decide. Trouble with workmen and with the collection of stock subscriptions hampered the company in its first works, the blasting out of Seneca Falls and Shenandoah Falls, and the building of a canal around Great Falls. After Washington's resignation from the presidency of the company upon assuming national office, affairs were poorly managed and almost nothing accomplished. The company was superseded by the CHESAPEAKE AND OHIO CANAL CO.

POTOMAC RIVER, a stream forming the boundary between Maryland and Virginia. It is a combination of two long branches which rise in the Allegheny Mountains in West Virginia and flow northeast in almost parallel lines through limestone valleys to their junction 21 mi. below Cumberland. From this point the river forms the boundary between Maryland and West Virginia and Maryland and Virginia to its mouth on Chesapeake Bay. The Shenandoah joins it at Harpers Ferry and on its course are Washington, D.C., Arlington, Alexandria and Mt. Vernon.

In the upper part of its course the Potomac crosses a number of ridges, forming water gaps and at Harpers Ferry cuts a gap nearly 1,000 ft. deep through the Blue Ridge, where it is noted for its strikingly picturesque scenery. Its course is rapid until it reaches the tide level at Washington, 110 mi. from its mouth. About 11 mi. above Washington the river descends 80 ft. in 1½ mi., forming a cataract 35 ft. high called Great Falls. The tidal portion is an estuary varying from 2½ to 7 mi. wide. The trunk stream is 358 mi. long, the south branch 103 mi. and the north branch 147. With its tributaries it drains 14,479 sq. mi. It is navigable to Washington.

POTOSÍ, a city of Bolivia, situated on the northern slope of the famous silver mountain, 15,668 ft. above sea level, the Cerro de Potosí. It is one of the highest habitations of the world, and the mountain, rising 2,000 ft. above the city, is dotted with mines which were once among the richest in South America. Many of these are closed, and the place has lost much

of its former prosperity. The climate is cold, averaging 48° F., with a maximum of 59° and a minimum of 9° below zero. The old Spanish colonial houses of adobe are vacant and in ruins. A mint, dating from 1773, is a historic landmark. Potosí was founded in 1545 and 50 years later the population reached 200,000 because of the mineral wealth of the region. Lack of railroad transportation and the distance from the sea caused its decline. Pop. 1930, 34,679.

POTSCHEFSTROOM ASSEMBLY, a gathering of 24 representatives from three Boer districts north of the Vaal River, convened on Dec. 16, 1856, to adopt a constitution. The draft constitution over which this assembly deliberated, and which it altered to some extent, was the work of a committee of three, including the later famous Paul Kruger, appointed by a Boer *Volksraad* which had met at Elands River in 1855. The actual wording of the document, and the arrangement of the articles, was entrusted to Jacobus Stuart, an educated Dutchman who happened to be on a visit to South Africa, and who was appointed secretary of the drafting committee.

At the assembly there was one representative for each of the field coronetries (areas including a certain number of households) in the three districts of Potchefstroom, Rustenburg and Pretoria. The delegates were empowered to adopt the final constitution and to appoint officials to the various executive posts in the first new government. The sessions at Potchefstroom lasted approximately three weeks. The constitution as finally adopted assigned the name South African Republic to the trans-Vaal settlement.

POTSDAM, capital of the Prussian province of Brandenburg and former second royal residence, situated on an island formed by the Havel River, a canal and several lakes, about 20 mi. southwest of Berlin. The city is regularly built with suburbs scattered among the many parks and woods. Among the important buildings are the Garrison Church, built in 1730-36, the St. Nicholas Church, the Holy Ghost Church, the Royal Palace, 1667-1701, the rathaus, 1753, and the huge Military Orphan Asylum. The industrial activity is not of great importance, though there are many small factories. Shipping, fishing and gardening are carried on extensively. Nearby are the New Palace, 1763-69, and the famous "Sans Souci," favorite residence of Frederick the Great. Pop. 1926, 65,795.

POTSDAM, a village in St. Lawrence Co., north-eastern New York. It is situated on the Raquette River, 30 mi. east of Ogdensburg, on the New York Central Railroad. Hydroelectric power is extensively developed; the chief local manufactures are paper and cheese. Potsdam is the seat of a state normal school, which now includes the Crane Normal Institute of Music. Clarkson College of Technology is located here. Potsdam was founded in 1803 and incorporated in 1831. Pop. 1920, 4,039; 1930, 4,136.

POTSDAM AGREEMENT. Prominent among the points of difference and dispute in Russo-German relations in the first decade of the 20th century

were the questions of the Bagdad railway and the commercial and financial exploitation of Persia. Germany was anxious to build the railway and also to secure a share of Persia's trade through the projected Bagdad-Khanikin branch of the line. Russia was opposed to the construction of the railroad since such an undertaking would not only strengthen Germany's economic and political grip upon the Near East, but would also materially increase the power of the sultan in his far-flung empire. On the other hand, Russia was anxious to monopolize the trade and resources of northern Persia. The conflicting interests of the two rival powers were reconciled and a compromise effected in a meeting at Potsdam in 1910 between Emperor William II, Tsar Nicholas II, and their respective ministers. The agreement, as signed on Aug. 19, 1911, provided that Russia would cease to oppose the Bagdad railway project; that Germany would seek neither railway nor other concessions in the north of Persia, and that the Bagdad line might eventually be linked, via Khanikin, with a Russian railway from Khanikin to Teheran.

POTSDAM CONFERENCE. On July 28, 1917, at the time when the cause of the Allied Powers was in a highly critical state, there appeared in the *London Times*, a leading article describing a so-called "Council" ostensibly held at Potsdam on July 5, 1914. The item claimed that at this council, which was said to have been attended by Emperor William II and by leading German and Austro-Hungarian diplomats and officers, the outline of the Austrian ultimatum to Serbia was drawn up and the decision to force a European war was arrived at.

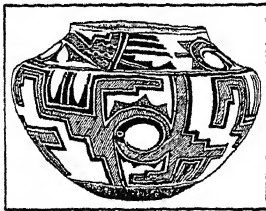
This piece of Allied propaganda, based largely upon gossip and upon the fanciful interpretation of certain vague references made by some German officials, including Prince Lichnowsky, former ambassador to Great Britain, was cleverly released for publication on the anniversary of the outbreak of the World War. The story, with embellishments untruthfully supplied by the German ambassador to Turkey, Baron Wangenheim, first came into prominent notice in the United States through the writings of Henry Morgenthau, American Minister to the Porte.

In the second volume of Professor Sidney B. Fay's *Origins of the World War* the entire story is proved to be legendary, as were so many of the wartime stories circulated to create moral sentiment against the Central Powers. The basis for the legend was a meeting at Potsdam, on July 5, 1914, at which the Austrian ambassador showed William II a letter from Francis Joseph expressing the necessity for punishing Serbia. The German emperor adhered to this view and, after talking the matter over with his chancellor, promised to help Austria-Hungary in the event that European complications followed upon the meting out of punishment to the Serb kingdom.

POTTER, HENRY CODMAN (1835-1908), American Protestant Episcopal bishop, was born in Schenectady, N.Y., May 25, 1835. He was graduated in 1857 at the Theological Seminary of Virginia and

in 1868 became rector of Grace Church, New York City. In 1887 he was consecrated bishop of New York. He accomplished much constructive social service work and many civic reforms in New York City, and was instrumental in getting plans for and starting the building of the Cathedral of St. John the Divine. He died at Cooperstown, N.Y., July 21, 1908.

POTTER, PAUL (1625-54), Dutch animal painter, was born at Enkhuizen, Nov. 20, 1625. He studied with his father, Peter Potter, and with Nicholas Moeyaert, but nature was his best teacher. He



POTTERY BOWL OF THE ZUNI
INDIANS OF NEW MEXICO

settled at The Hague where he painted the *Young Bull*. This life-size, highly realistic painting made Potter's reputation. Yet he was more successful with his small canvases, which are accurate, objective and well observed. Potter is represented in the Rijksmuseum, Amsterdam, the Dresden Gallery and the Hermitage, Leningrad; the best of his small studies of horses are in the Schwerin Gallery and the Louvre, Paris. The painter died at Amsterdam, Jan. 15, 1654.

POTTERY, objects or articles fashioned from moist clay and hardened by heat. In its broader sense, this term includes products which range from ordinary bricks to the finest porcelain. Common usage, however, restricts the term to the earthenware and stoneware products which lie between these two extremes. Pottery is dependent on two natural properties of clay; namely, the plasticity of the wet material which allows molding into any form, and the transformation of this plastic material by heat into a hard substance of great durability. It was the product of no one people. Wherever prehistoric man had access to plastic clay, the rudimentary manufacture of pottery resulted. This elementary process included digging the clay from the ground, shaping it and baking it before an open fire.

The early vessels were designed solely for use. The first attempts at decoration were the scoring of the unbaked clay with lines and symbols. The use of a kiln to shield the objects from too close contact with the fire was one of the first improvements in pottery manufacture, and this development took place independently in many countries. The potter's wheel, the first mechanical aid employed, was invented by some

unknown early genius. It is known to have existed many centuries before Christ. The principle of the potter's wheel embraces the shaping of a lump of clay by the revolution of a horizontal disk on which the clay has been placed.

Pottery is divided into two classes, soft and hard. Soft pottery is easily scratched and is more destructible than the hard. This class includes unglazed, lus-

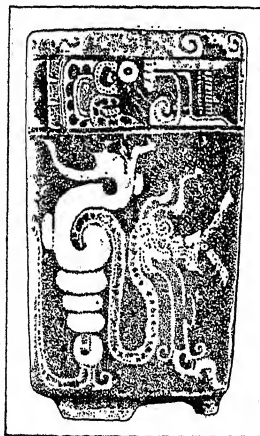


COURTESY METROPOLITAN MUSEUM OF ART

AMPULLIAN POTTERY VASE

trous, glazed and enameled pottery. The unglazed is the crude untreated ware. Lustrous pottery is covered by a thin glaze which may be colored by the addition of a metallic oxide. Glazed ware bears a heavy glaze usually produced by the use of lead or some alkali, often salt. Enameled pottery is baked unglazed, then covered with a coating of enamel and rebaked. FAÏENCE and MAJOLICA are forms of enameled pottery. Hard pottery or stoneware is pottery composed of clay mixed with sand and other substances.

The earliest development of pottery from a craft to an art took place in Egypt, Assyria and ancient Babylon. Assyrian excavations have unearthed finely glazed and richly colored tiles which indicate a perfection of processes and an extraordinary knowledge of materials. The striking contribution of Babylon to the early development of pottery was the pictured brick and the colored enameled tiles used in Babylonian architecture. Examples of Egyptian potteries show that the Egyptians excelled in molding their vessels, in decorating them and in the use of brilliant colors and beautiful glazes. The Egyptian faïence, brilliant in coloring, and produced as early as 4000 B.C., is unique. This ware was mostly confined to the production of beads, plaques, amulets, scarabs and finger rings.

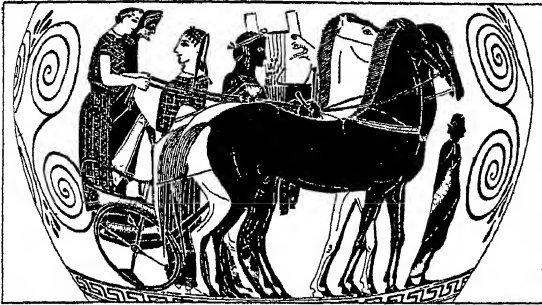


COURTESY AMER. MUS. OF NATL.
HISTORY

MAYA POTTERY VASE

The polychrome decoration shows a feathered serpent emerging from a snail's shell. Found at Nexapa, Salvador

Important early Greek potteries include the painted vases of black figures on a buff or red clay ground, or of red figures on a black ground. The Greek "geometrical vases" have decorations derived from the circle and the straight line, with the motives, human figures, animals or plants arranged in a geometrical pattern. Ancient Chinese pottery passed through all the early stages, until the Chinese carried the potter's art to its highest development in the invention of



COURTESY M. M. OF ART

SECTION OF A BLACK-FIGURED GREEK VASE OF THE 6TH CENTURY B. C., ATTRIBUTED TO THE POTTER EXEKIAS
A chariot in a marriage procession is pictured

porcelain. (See CHINAWARE.) The most outstanding of the early Roman pottery is the Arrentine ware, which ranged in color from pale salmon-pink to deep coral-red.

Specimens of pottery discovered in Peru indicate an early Peruvian civilization. The pottery of the Mound Builders, found in Mississippi and Ohio, while not so well finished, resembles the Peruvian ware. That found in the pueblo region in the southwestern United States and in Mexico shows a high degree of artistic development.

For centuries there is a lapse in ceramic history. From the 10th to the 16th century Persia produced a



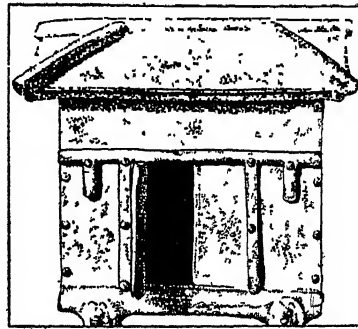
COURTESY AMER. MUS. OF NATL. HISTORY

POTTERY OF THE HOPI INDIANS OF ARIZONA

wealth of exquisite tiles which decorated tombs, mosques and other elaborate buildings. Persian pottery for the most part had a groundwork of white; the decorations of blue, green or purple were outlined with heavy black or brown lines. The exquisite Persian luster ware, which directly influenced later decorative pottery, is the first known example of painting on the glaze and then refiring. African pottery flourished in the 11th century, and was borne to Spain during the invasion of the Moors. Its most important development was the luster ware known as Hispano-Moresque pottery, with a white ground bearing designs in color, to which the *lustre* was added.

The development of the potter's art in European countries was sluggish compared to that in the Orient and the Far East. In the 15th century European wares were clumsily fashioned and rudely decorated. The superior pottery of the Moslem nations and the porcelains of China had been introduced as articles of luxury for wealthy Europeans, and Italian potters were experimenting on improvements. LUCA DELLA ROBBIA, the inventor of stanniferous white enamel, perfected the first Italian majolica ware. For a time Italian pottery flourished under the patronage of royalty, and the wares of this period represented the highest achievement in European pottery.

From this time ceramic art in Europe progressed slowly but steadily. Early in the 17th century the Dutch established a pottery at Delft, and developed the distinctive Delftware bearing the extremely full decoration of blue on a white ground. In France the important 16th century potteries included the wares of Bernard Palissy and the *faience d'Oiron*. Tin enamel wares were first successfully manufactured in



COURTESY AMER. MUS. OF NATL. HISTORY

POTTERY MODEL OF A HOUSE, HAN DYNASTY

the Normandy potteries, of which Nevers was the earliest and Rouen the most celebrated. The success of these manufactures led to the establishment of many potteries elsewhere in France. The style for *faience* was set by the potteries of Strasbourg and Marseilles with flower painting.

In Holland the Italian art of majolica painting soon achieved distinction. It spread to Germany and was developed there with characteristic vigor, although in Germany painted pottery did not attain the importance of the sturdy stoneware with its sombre or mellow tones.

English pottery was evolved along individual lines. In the Stuart period the slipwares of Staffordshire and other potteries appeared, and later the salt-glazed stoneware. As the industry grew at Staffordshire, a great diversity of technical methods was brought into use. The genius of Wedgwood and the expansion of the industry developed new standards of workmanship. Wedgwood introduced "black basaltes" ware, jasper ware, and a fine stoneware of various colors which was decorated with cameo reliefs in white. In the decoration of Queensware he introduced transfer printing. Cream-colored ware was made at Leeds and

at other places in Yorkshire, and the earthenware made at Burslem became important.

With the acquisition of mechanical aids in the 19th century, supremacy in the potter's art passed from the



COURTESY W. M. OF ART

AMPHORA BEARING A DESIGN REPRESENTING THE DISPUTE BETWEEN APHRODITE AND PERSEPHONE OVER ADONIS

Orient to the Western world, with England leading the industry. The cream-colored ware of Staffordshire commanded a world market, much of which it has retained. But with mechanical methods superseding handicraft, and with adoption of the English device of replacing painted decoration with machine printing, the output was increased at the cost of artistic distinction. The 20th century found the master potters of all countries making great efforts to combine the art and skill of former days with modern manufacturing facilities. France and Denmark are the important centers of the ceramic art in Europe to-day. In America, outstanding potteries include the Rockwood pottery in Cincinnati, O.; the Flint enameled ware manufactured in Bennington, Vt., and in Baltimore, Md.;

and the green-glazed Grueby faience of Boston, Mass. Statistics of the pottery industry in the United States are as follows:

POTTERY INDUSTRY, U.S.

Item	1929	1927
No. of establishments	307	316
No. of wage earners	34,958	36,667
Total wages	\$ 43,365,195	\$ 45,149,818
Cost of mat., fuel & elec. current	27,136,435	33,580,795
Total value, pottery products	108,757,233	110,597,338
Val. added by manufacture	81,620,798	77,016,543
Val., per wage earner, added by mfg.	2,335	2,100
Principal Products:—		
Red earthenware	2,605,947	2,850,428
Stoneware, yellow, and Rockingham ware	3,405,973	4,503,079
Chemical stoneware	1,111,382	985,732
Whiteware	31,568,730	31,692,083
Hotel china	11,081,788	10,019,528
Vitreous & semi-vit. plumbing fix.	27,886,993	29,093,560
Porcelain elec. supplies	21,349,914	22,860,678
Art pottery	2,211,092	2,156,250
Saggers	1,031,417	1,915,950

BIBLIOGRAPHY.—R. L. Hobson, *Art of the Chinese Potter*, 1924; F. Litchfield, *Pottery and Porcelain*, 1925; C. Dugas, *Greek Pottery*, 1926.

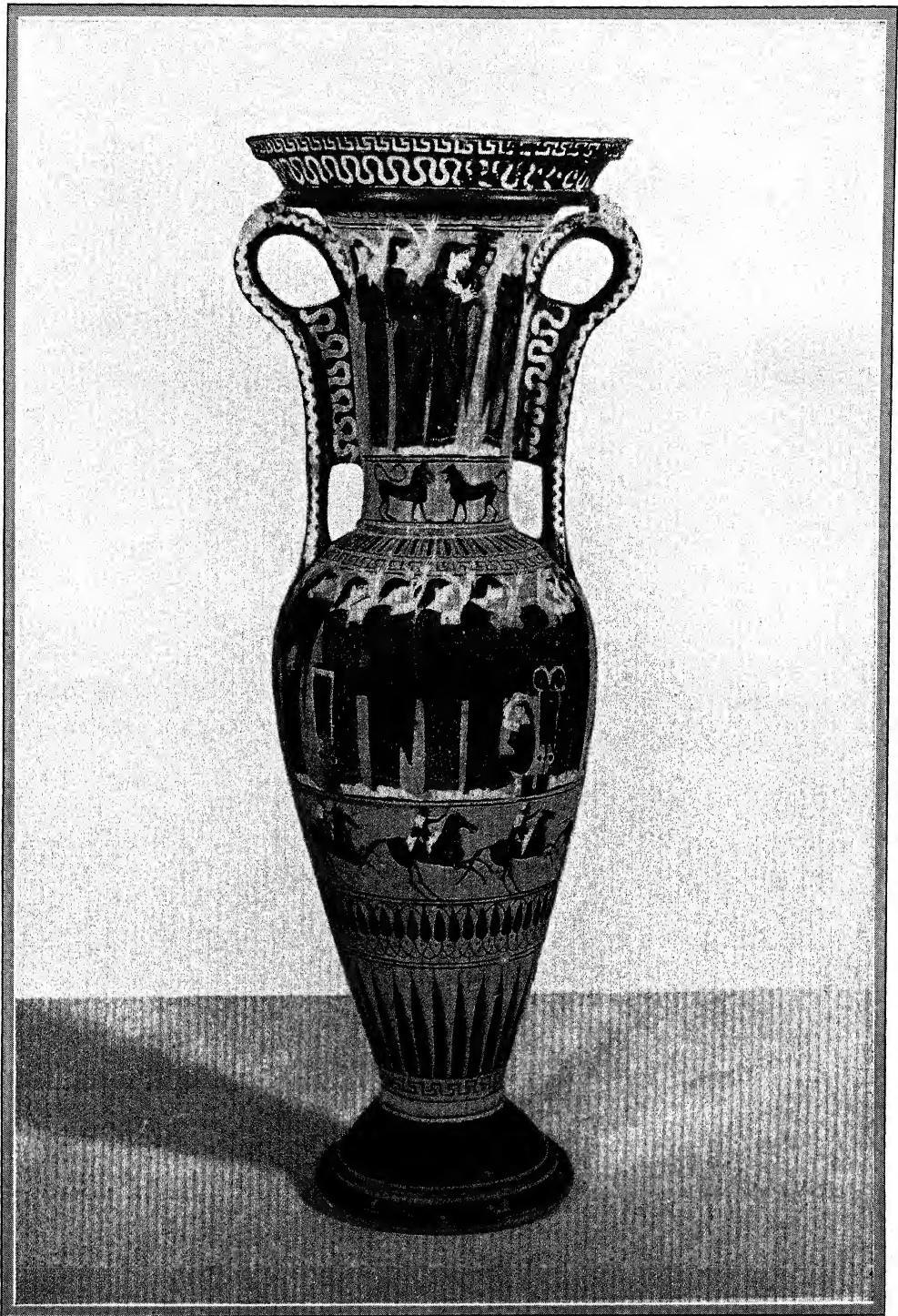
POTTSTOWN, a borough of Montgomery Co., Pa., about 40 mi. northwest of Philadelphia on the Schuylkill River and served by the Pennsylvania and the Reading railways and motor buses. It is a trading and manufacturing center. In 1929 aggregate manufactures, consisting chiefly of iron and structural steel work were valued approximately at \$31,000,000; the retail trade amounted to \$11,885,969. Nearby is a park of 300 acres where glacial rock formations give forth musical tones when struck. America's first important iron furnace was constructed nearby in 1716. Founded in 1753 by John Potts, the settlement was called Pottsgrove until 1820. The neighborhood saw Revolutionary War maneuvers. Gen. Arthur St. Clair, first president of the Continental Congress, lived in Pottstown. It was incorporated as a borough in 1815. Pop. 1920, 17,431; 1930, 19,430; 7% were foreign-born.

POTTSVILLE, a city in eastern Pennsylvania, the county seat of Schuylkill Co. It is situated on the Schuylkill River, 90 mi. northwest of Philadelphia; it is served by three railroads. The city is in the Schuylkill region, a highly productive anthracite district. Mining is the leading industrial interest; there are also foundries, railroad shops and various factories. In 1929 the manufactured output was worth about \$15,000,000; the retail trade reached a total of \$16,019,717. Those first to arrive soon met their end at the hands of hostile Indians in August, 1780. Permanent settlers came in about 1795, and an iron foundry was established. The discovery of coal occurred in 1807. Pottsville was platted in 1816, became a town in 1828, the county seat in 1851 and a city in 1913. The criminal activities of a secret and lawless society of Irish miners known as the MOLLY MAGUIRES occurred here in the early 70's. The leaders were finally executed in 1877 and 1878. Pop. 1920, 21,876; 1930, 24,300.

POUGHKEEPSIE, a city of southeastern New York, and the county seat of Dutchess Co., situated on the eastern bank of the Hudson River, midway between the Catskills and the Highlands, about 73 mi. north of New York. Transportation facilities include the New York Central and the New York, New Haven and Hartford railways and bus lines. Among the manufactures are foundry products, candies, clothing, cigars, milk separators and preserves. In 1929 the value of the factory output was about \$30,000,000; the retail trade amounted to \$31,108,139. VASSAR COLLEGE, Putnam Hall and the Eastman Business School are located in or near Poughkeepsie. The Dutch settled here about 1698, and named the village for a small waterfall, the Indian name signifying "here the waters break through." Between 1788 and 1795 the New York legislature met several different years in the town. In 1799 Poughkeepsie was incorporated and in 1854 obtained a city charter. Pop. 1920, 35,000; 1930, 40,288.

POULSEN, VALDEMAR (1869-), Danish engineer, born at Copenhagen, Nov. 23, 1869. In 1898 he invented the telegraphon, a combination of

POTTERY

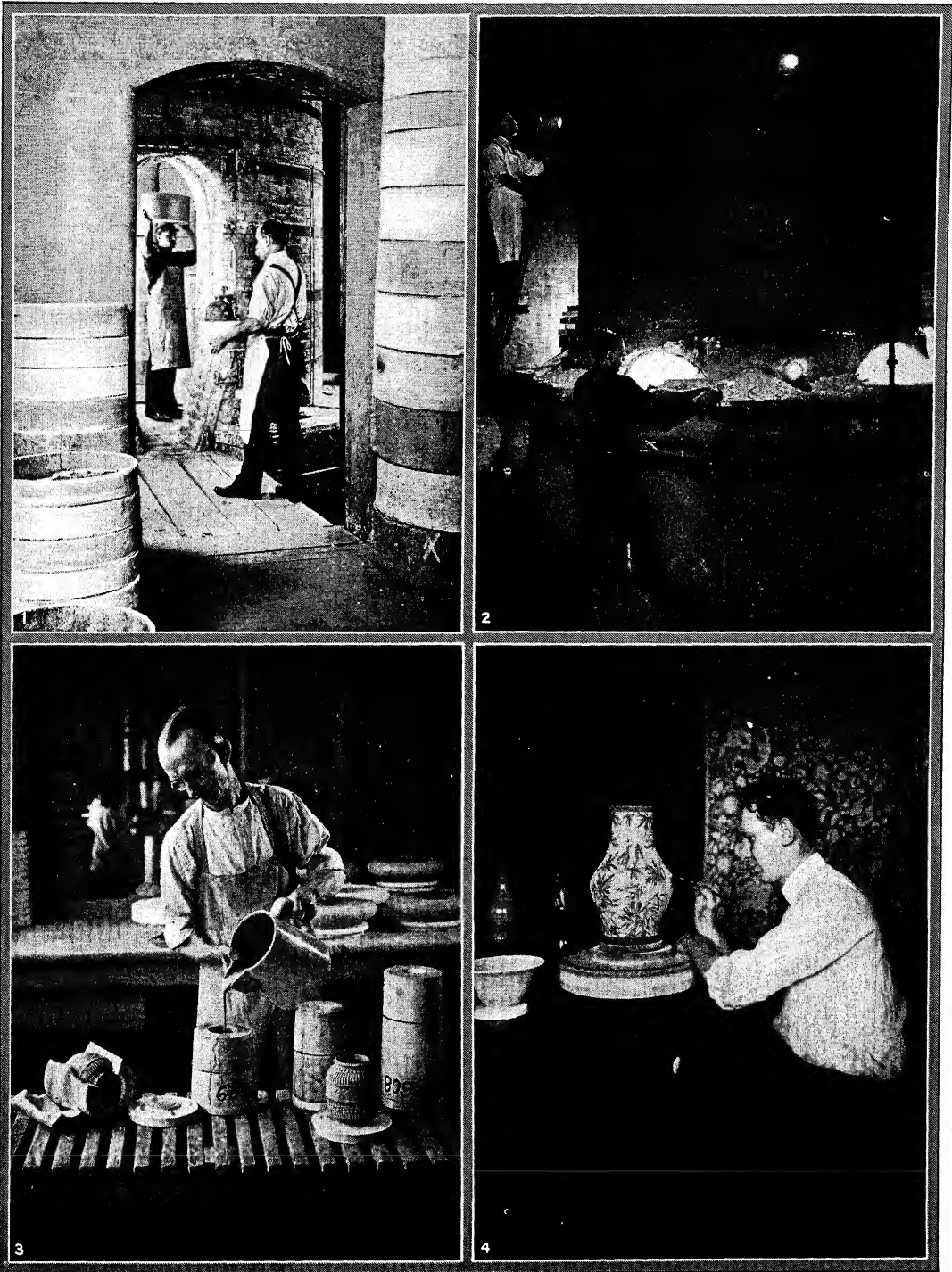


COURTESY METROPOLITAN MUSEUM OF ART

LOUTROPHOROS OR "MARRIAGE VASE"

Attic vase of the late 6th century, known as a sepulchral *Loutrophoros* because it was erected on the tomb of an unmarried person, or one dying during betrothal. This is the only known well-preserved specimen of its kind.

POTTERY



COURTESY THE ROOKWOOD POTTERY CO.

STEPS IN MAKING POTTERY

1. Placing saggars (boxes made of fire clay) filled with delicate pieces in the kiln.
2. Burning the kiln.
3. Casting an irregular shaped vase from liquid clay.
4. Decorating a wet clay vase with clays colored by mineral oxides.

POTTERY



1



2



3

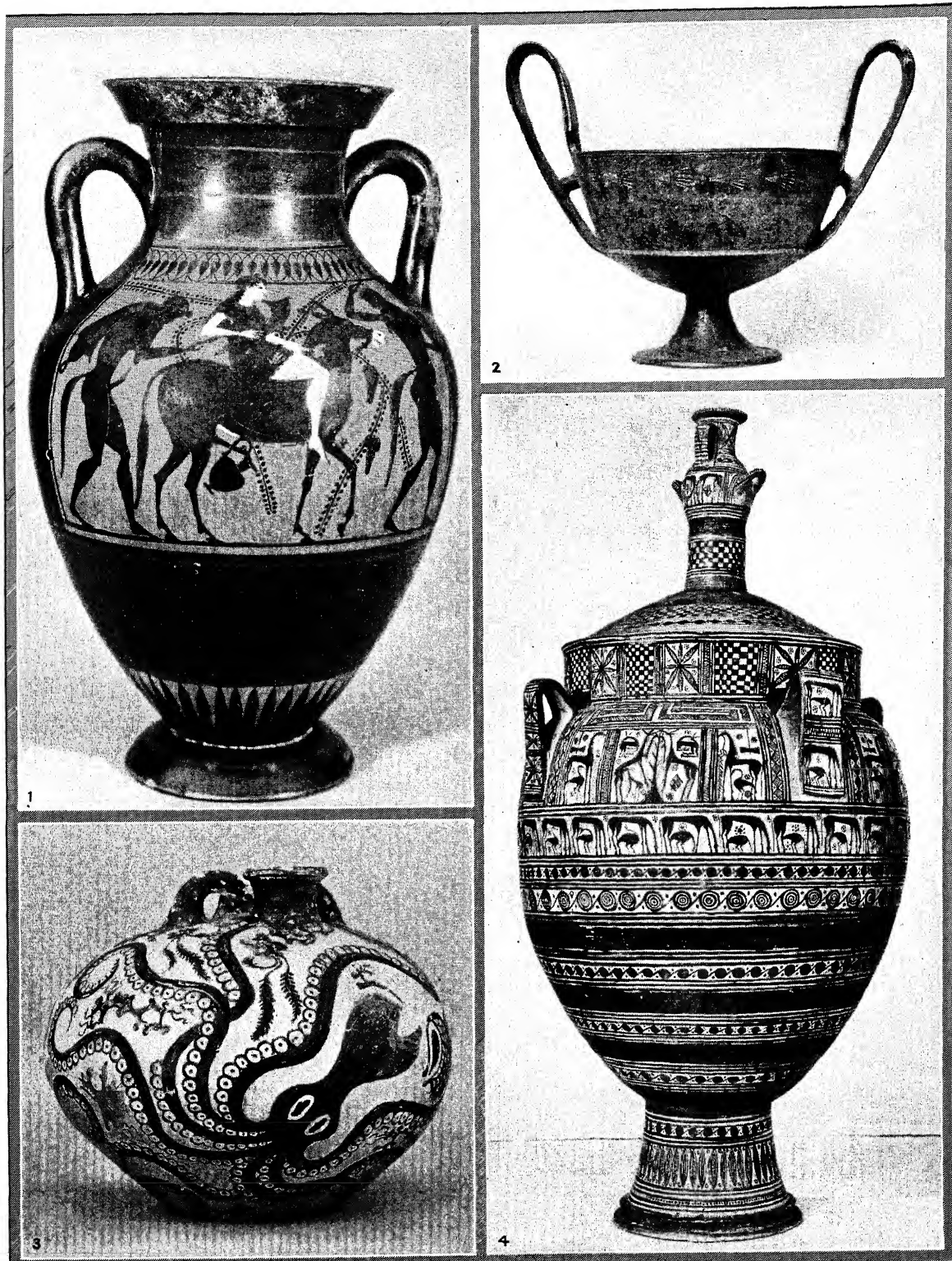


4

EVOLUTION OF A CLAY VASE ON THE POTTER'S WHEEL

1. With his model nearby, the potter sets his wheel spinning. 2. The shapeless mass of clay gradually takes form under his guiding fingers.
3. Shaping the neck of the vase out of the still pliable clay. 4. Ready for the oven. At this stage the vase is painted or decorated.

POTTERY



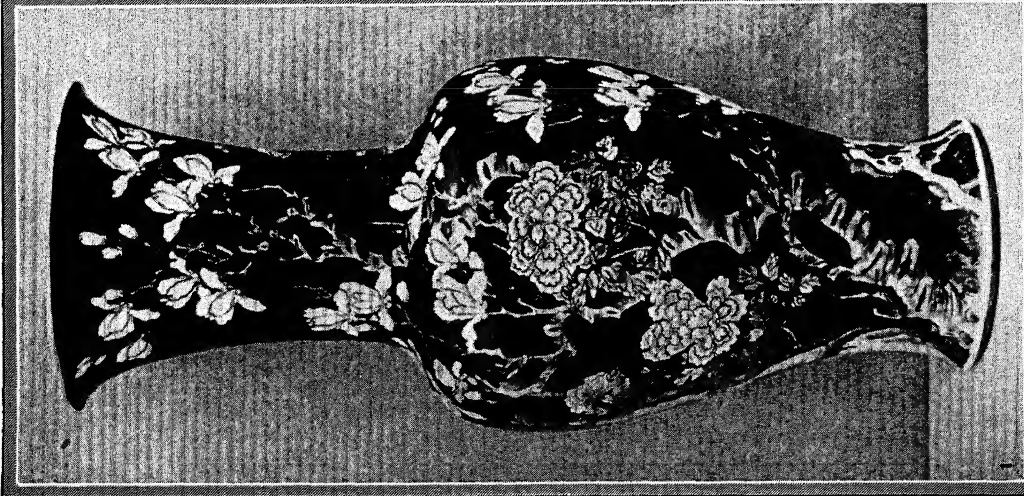
COURTESY METROPOLITAN MUSEUM OF ART

EARLY GREEK AND ETRUSCAN POTTERY

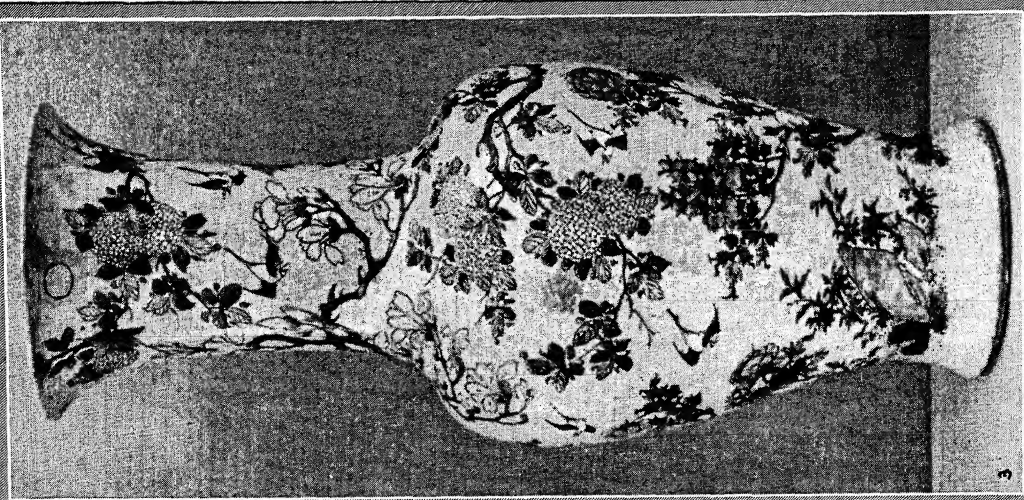
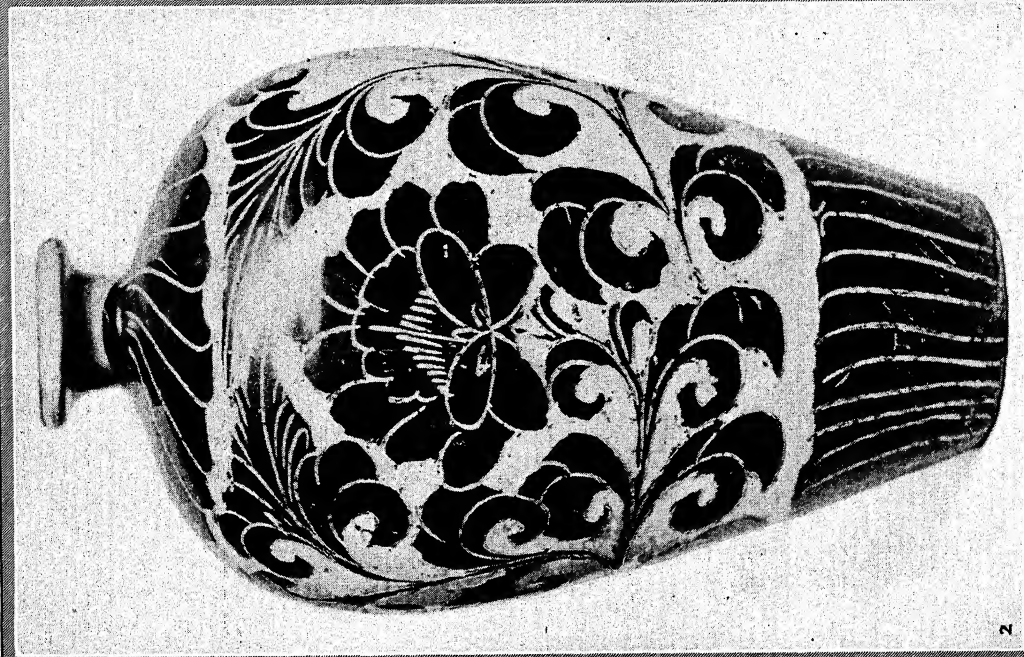
1. Black-figure amphora of the 6th century B.C. on which is pictured a maenad riding a mule, and two satyrs. 2. A bucchero kantharos, or Etruscan black pottery drinking

cup, 7th-6th century B.C. 3. Minoan false-necked vase about 1600-1500 B.C. 4. Vase of Cyprus (possibly Attic) with geometric design, 900-800 B.C.

POTTERY



COURTESY METROPOLITAN MUSEUM OF ART



CHINESE PORCELAIN AND POTTERY

1. Porcelain vase in Famille Noire style, so-called from its green-black background, made during the reign of K'ang Hsi (1662-1722).
2. Black and white jar of the Sung Dynasty (about 1108 A.D.).
3. Porcelain vase in Famille Jaune style (yellow background), K'ang Hsi period.

long distance telephone and sound recording disk. Devoting his attention to wireless, he invented improvements, looking toward wireless telephony and in 1903 developed the Poulsen arc, a high frequency radio transmitter.

POULTRY. The word poultry, although usually applied to ordinary chickens and hens, covers in general all fowl subject to domestication for commercial purposes. Thus it includes turkeys, geese, ducks, guinea fowl and possibly even peacocks and swans, once thought edible and still bred for ornamental purposes.

For the guinea fowl, really an African pheasant, there is a small but steady demand as a table delicacy. The domestic duck is a direct descendant of the wild mallard; most general in America is the white Peking, the Indian runner being also considered good. In England, the white Aylesbury is most popular, while the larger Rouen is also much seen. Domestic geese trace directly to the wild migratory graylag. The gray Toulouse and white Embden are general abroad, while American breeders favor the large African goose. Except perhaps in Germany, the popularity of the goose has waned considerably. The turkey is the great contribution of the North American continent to the table. This magnificent bird is not easy to raise, but is bred in constantly increasing quantities for eating. However, the ordinary domestic fowl leads all others in supplying civilized man with poultry flesh and eggs, and contributes largely to his economic welfare.

The cock was known in China thousands of years ago, chickens being depicted on the tomb of Mera, about 3200 B.C. An ancient Chinese dictionary defined it as "the domestic animal which knows the time." At an early date, the domestic fowl reached Persia, Greece and Scythia, spreading through Europe and into the British Isles, where the Romans found it. As important as its utilitarian purposes was the use of the animals for cock-fighting, and the sport, mentioned by ancient as well as more modern writers, did much to improve the breed and widen its distribution. The first importations to America, from England, Europe and Asia, occurred early in the 17th century. In 1849 was held the first American poultry show, and in 1874 appeared the first "Standard of Perfection," which assured the stabilization of the breeding industry.

Chickens, turkeys, guinea fowl and pheasants belong to the order *Gallinae*. The sub-order *Gallus* includes cock-like birds of four species, most important of which is *Gallus bankiva*, the red junglefowl of eastern India and nearby Asia. In 1868, Darwin stated that all domestic species originated with the red junglefowl; the theory has been generally accepted, in spite of some dissension. The other three species, *Gallus lafayetti*, the Ceylon junglefowl; *Gallus sonnereti*, gray junglefowl, and *Gallus varius*, the Javan junglefowl, will all mate with each other and with domestic fowls. The readiness of these birds to interbreed has resulted in an enormous number of

breeds and of varieties, but the major strains are well recognized and established. The old saying that "shape makes the breed and color the variety" suffices for the layman; there is available more detailed information for the breeder.

The four main groups of breeds are American, Asiatic, English and Mediterranean. The game breeds, striking in appearance, are prized by fanciers; there are other miscellaneous breeds.

American Breeds have yellow skins and clean shanks. They lay brownshelled eggs and are naturally broody. They include: Dominique, a small, barred bird, once common, now little seen.

Plymouth Rocks, raised both for flesh and eggs; sturdy, single-combed birds in several color varieties, including barred, developed from Cochin and Dorkin; White, a sport from barred; Buff, with some Rhode Island Red blood; Silver-Penciled, from dark Brahma strains; Partridge, Columbian and Blue.

Wyandotte, a round-bodied, general purpose bird with rose combs; included are the striking Silver-Laced, White, a sport, Buff, Golden-Laced, Partridge, Silver-Penciled, Columbian and Black.

Rhode Island Red, with long, rectangular body, good for both meat and eggs. This breed was developed in the 19th century by mating Red Malay game cocks to common hens, with some brown Leghorn blood. The brownish-red plumage has black markings. Varieties have both single and rose combs.

Jersey Black Giant, the largest fowl in America, developed largely from Asiatic sources. The plumage is black with greenish sheen.

Other breeds are the Java, from the black Cochin; the Buckeye, an American mahogany-colored bird of many strains; and the white chanticler, of Canadian development.

Asiatic Breeds have large bodies, yellow skins and feathered shanks.

Brahma, massive, well-feathered, sturdy; from the Brahmaputra district of India, where fowls of the original type are called "gray chittagongs."

Cochin, sometimes called Shanghai fowl, a very heavily feathered bird; Buff, White, Partridge, Black.

Langshan, a graceful bird little seen to-day.

English Breeds have been developed for utility. All but the Cornish have white skin and are broody.

Orpington, a long, deep, well-rounded bird, excellent for the table; Black, Buff, White, Blue.

Cornish, developed the middle of the 19th century, has close feathers and compact, well-meated body.

Sussex, a table bird developed about 200 years ago, resembling Dorking, a long, broad, deep-bodied fowl with five toes.

Less familiar breeds are the Red Cap and the Australorp, developed from the Black Orpington in Australia recently.

Mediterranean Breeds are smaller than the Asiatic; they are represented in America very widely by the Leghorns, bred for eggs and sometimes as broilers. All have non-feathered shanks, lay whiteshelled eggs and are non-broody. Other varieties are the Ancona,

also a native of Italy; the Minorca, from the Balearic Islands; the White-Faced Black Spanish and the Blue Andalusian.

Breeds well known in Europe are the Houdan, a French five-toed general purpose bird; the French Faverolles, Crevecouer and La Fleche; the Belgian Campine and Sicilian Buttercup. Polish Fowls, descended from old Italian strains and crested, are recognized largely as fancy fowls. Hamburg, Malay, the picturesque long-tailed Yokohama of Japan and the South American Araucana which lays blue tinted eggs, are miscellaneous breeds, as are the Silkie Frizzle and Sultan.

All breeds and varieties show many varying characteristics. The skin is yellow, white or black; the egg varies in size, shape, color. The Bankiva has a single comb, but modern domestic fowls have four types, single, rose, pea and walnut. All male birds have more noticeable combs, wattles and tail feathers than females, as well as spurred shanks, rarely seen on females.

BIBLIOGRAPHY.—M. A. Jull, *Poultry Husbandry*, 1930.

POULTRY HOUSES. Poultry thrives in a shelter that is dry, light, warm and sanitary. Two to five sq. ft. of floor space are required per fowl, depending upon the breed. A common type of poultry house is 16 to 20 ft. wide and divided into pens which are of about that length; each pen shelters from 100 to 200 fowl. Movable brooder houses of smaller size, about 12 by 14 ft., and colony coops, about 4 by 8 ft., are quite common in some sections. Roosts, dropping boards, nests, feeders and waterers are essential pieces of equipment.

BIBLIOGRAPHY.—W. A. Foster and D. G. Carter, *Farm Buildings*.

POULTRY-KEEPING, the breeding and maintenance of various domesticated birds, was once merely incidental on farms. The fowls lived upon what food they could find on free range with a little supplemental dole by the farmers. Under this lack of system, whatever eggs and carcasses they yielded were so much gain. For these reasons and because they thrive anywhere, multiply rapidly and are not individually valuable, add variety to the menu and supply pin money to the farmer's wife, they are now found on most farms the world over.

As they are largely or wholly self-supporting when not penned they have been generally neglected until within the past half century. But during this period they have attracted such wide and deserved attention they are now raised in immense flocks, either for egg production or for meat. In fact, certain districts have developed actual industries along these lines. Petaluma, Cal., is noted for its eggs; eastern Long Island for its ducks. Individual farms in each of these districts raise 50,000 birds annually.

Such developments are due to several factors as important in their application as in the breeding and rearing of other livestock. Although various breeds have been valued mainly for egg production, others for meat and although for many years prior to the

present commercial development great attention was paid to breeds and breeding for exhibition purposes, little was paid to the economic phases of the subject until the agricultural colleges and experiment stations took up poultry raising scientifically. The results have been that countless discoveries have been made, published and applied all over the country with inestimable profit to individuals and the nation.

One of the applications of these experiments is the development of wholly new methods of feeding such as balanced rations constantly kept within reach of the fowls which feed at will. Another is the development of artificial hatching and rearing in order to meet the needs of large scale poultry producers. Incubators and brooders have been perfected so that the largest sizes hatch hundreds of thousands of eggs annually doing a custom business in hatching not only for local demand but in day-old chicks sent by express and parcel post hundreds of miles. The latest development is the process of battery brooding by which newly hatched chicks are reared to market age in cages wholly under artificial light and by means of special feeding.

The most striking development is the establishment of fecundity in hens. Whereas, according to the U.S. Census Report of 1900 the average number of eggs laid was 65 per hen, careful breeding and selection, coupled with rational feeding, good care, comfortable quarters and trap-nesting have developed whole flocks whose annual average records are more than 200 eggs a hen with many individual hens laying more than 300. One Black Orpington trapnested at Taranki, N.Z., held the record in 1930 with 361 eggs in 365 days, and a Barred Plymouth Rock at Saskatchewan, Canada, with 358 in 1929. Other noteworthy developments are in the shortening of the time necessary to raise pullets from chickhood to laying age; proof that pullets are more profitable than older fowl to keep for egg laying but less valuable as producers of chicks; insuring supplies of eggs by hatching at specified times; determining the average per hen cost of rearing and maintaining flocks of fowls and similarly determining the average profits.

From the standpoint of economic influences, poultry raising, especially for flesh, doubtless best fits in general farming because it is adapted to virtually every type, because more or less feed that might otherwise be wasted can be utilized at a profit and because fowls are always healthier and more fecund on range than when confined. Yet it is on just such farms that it is still most neglected, the farmer holding the opinion that his other interests are more important and profitable. Nevertheless, poultry raising has been proved to yield a larger percentage of profit on the investment than any other department of general farming—exclusive of pure bred animals, seed grain and other specialties. For some years the agricultural colleges and secondary schools have been teaching these principles to ever increasing numbers of interested long and short term students and to farmers direct through annual gatherings.

Chickens are naturally the most important of all domestic poultry, being most adaptable to all sorts of farm conditions and capable of being used as egg and meat producers. Although certain breeds are

CHICKENS ON FARMS, U.S.

4-Year Average, 1927-30

Division	Value per Head (Cents)	Number	% of Total
UNITED STATES	93.39	456,492,000	100.0
LEADING STATES:			
Iowa	87.00	32,716,000	7.2
Missouri	87.00	31,798,000	7.0
Illinois	97.00	27,740,000	6.1
Ohio	98.00	23,894,000	5.2
Texas	70.00	22,692,000	5.0
Kansas	80.00	22,602,000	4.9
Pennsylvania	120.00	19,709,000	4.3
Indiana	94.00	18,439,000	4.0
Minnesota	78.00	17,526,000	3.8
California	112.00	15,840,000	3.5

more noted than others for egg production, strains or varieties of the so-called meat breeds have been developed along egg laying lines until they vie with even the best of the egg laying breeds: Leghorns, Minorcas, Hamburgs, Spanish, Andalusians, Hondans, and Polish. The meat breeds are Plymouth Rocks, Wyandottes, Rhode Island Reds, Orpingtons, Dorkings, Langshans and Brahmas.

Next in importance are the ducks, of which in America the Pekin is the leader and in Great Britain the Aylesbury, both raised in prodigious numbers for market. The breeding flock is allowed to exercise in ponds or streams but the young ones intended for market are not. They are fed abundant roughage together with grain and grit and are sold for the table as "ten weeks ducks." Geese are less amenable than chickens or ducks to development in large flocks because of their monogamous habits and the large range they require. Another factor that limits their production is their large size.

Turkeys require careful handling because many die while young. On damp soils, in damp climates and where showers and fogs are frequent during the developing period they are raised with considerable difficulty, but where the soil and the climate are dry and where they may have free range after the risky stage mentioned they practically care for themselves until time to fatten them for the table where they play the most important of all poultry rôles. M. G. K.

POULTRY-LICE, several species of *BIRD-LICE* of the order *Mallophaga*, which infest poultry. The mouthparts of these insects are fitted for chewing, while true lice have sucking mouthparts. They are flattened, wingless creatures, provided with sharp claws for clinging to the host and feeding upon feathers and dermal scales. The irritation they produce may cause the death of young chicks. Eggs or nits are glued singly to the feathers. In warm weather this may hatch in ten days. There are several generations a year. It is to rid themselves of these pests that poultry wallow in dust. Sodium fluoride, applied as

a powder to the body of the fowl, is one means of control. Painting the perches with 40% nicotine sulphate is even more effective.

POULTRY-MITE, mites of the family *Gamasida*. One of the commonest is the chicken mite, which sucks the blood of the host. It is pale yellowish to red in color, and can be plainly seen. It feeds upon the fowls at night, but during the day conceals itself on the perches or in convenient crevices. Its eggs are laid in the hiding places. These mites may cause the death of weak or unhealthy fowls. Painting perches frequently with nicotine sulphate is the best method of control. Depluming mites sometimes attack poultry. They work at the bases of the feathers, causing itching. To control this mite, dip the fowl in a solution of sodium fluoride. Scaly-leg mites cause "bumble foot" by burrowing into the skin. Soak the chicken's legs in warm water, then dip in crude petroleum.

POULTRY-TICK, a common name for a species (*Dermanyssus gallinae*) of mite, more properly known as the chicken or red mite, which sucks the blood of fowls and cage birds at night. Sometimes it also attacks man, dogs, cats and horses. It has an oval, red body, about 7/25 inch long. During the day it hides in cracks and crevices. Often it is a troublesome pest, and it is very harmful to the birds. See also *Mites*.

POUND, EZRA LOOMIS (1885-), American poet, was born in Hailey, Idaho, Oct. 30, 1885. He was educated at Hamilton College and at the University of Pennsylvania. From 1917-19 he was London editor of *The Little Review*, and later edited *Exile*. His first poems, *Personae*, appeared in 1909, followed, among many other books, by *Cathay*, 1915; *Umbra*, collected early poems, 1920, *Cantos*, 1925 and 1928, *Personae*, later collected poems, 1926, and *XXX Cantos*, 1930. In 1927 Pound received the *Dial* Award of \$2,000.

POUND, ROSCOE (1870-), American jurist and educator, was born at Lincoln, Neb., Oct. 27, 1870. He graduated from the University of Nebraska in 1888, taking his Ph.D. there in 1897, and studied at the Harvard Law School from 1889-90. In the latter year he was admitted to the bar and practiced in Lincoln from 1890-1901 and again from 1903-07. He was assistant professor of law at the University of Nebraska 1899-1903 and for the following four years dean of the law department. From 1907-09 he was professor of law at Northwestern University; and 1909-10 at the University of Chicago. In the latter year he went to Harvard University as professor of law, being appointed dean of the Law School in 1916. He is an acknowledged authority in jurisprudence and recognized leader in legal education. His views on legal controversies are widely sought. Pound was commissioner on uniform state laws 1904-07 and member of President Hoover's National Committee on Law Enforcement 1929-31. He was the editor of the department of law for *The National Encyclopedia*, 1932. Among his writings are *Phytogeography* of

Nebraska (with Dr. F. E. Clements), 1898; *Readings on the History and System of the Common Law*, 1904; *Outlines of Lectures on Jurisprudence*, 4th ed., 1928; *Law and Morals*, 2nd ed., 1926; and *Criminal Justice in America*, 1930.

POUND, a measure of weight of two different values, the avoirdupois pound of 7,000 grains and the troy pound of 5,760 grains. The former is the common pound and is used for all commodities except precious metals and medicines, for which the troy pound is the standard weight. The pound avoirdupois was legally adopted in 1832 by act of Congress with the same relation to the pound troy that it had borne in England. The pound troy was supposedly introduced into England from France at the beginning of the 15th century. The standard unit of weight in the English system was the Saxon pound, later known as the Tower pound. It weighed 5,400 grains, its weight in silver being coined into the monetary pound. Another ancient English pound was the merchant's pound, established in 1270.

POUNDAL. See **FORCE**.

POUND STERLING. See **STERLING**.

POWDER, FACE. See **FACE PREPARATIONS**.

POWDERED COAL. See **PULVERIZED FUEL**.

POWDER RIVER, a tributary of the Yellowstone, rising in the Big Horn Mountains of Wyoming out of the confluence of numerous creeks. It flows northward through Johnson and Sheridan counties, Wyo. and maintains the same direction through Powder River and Custer counties, Mont. before discharging into the Yellowstone at Terry in Prairie Co. The stream measures approximately 400 mi. Its chief tributaries are Crazy Woman and Clear Creek from the west and Mizpah and Little Powder from the east. The area drained is a fertile agricultural region.

POWELL, JOHN (1882-), American pianist and composer, was born at Richmond, Va., Sept. 6, 1882. He studied the pianoforte with LESCHETIZKY and composition with Nawratil at Vienna. He made his début at Berlin in 1907, appearing later at Vienna, Paris, and London, and toured Europe as soloist with the New York Symphony Orchestra. His compositions are in modern style, and frequently employ negro themes.

POWELL, JOHN WESLEY (1834-1902), American geologist and ethnologist, was born at Mount Morris, N.Y., Mar. 24, 1834. During the Civil War he served in the Union Army as a major and lost his right arm at Shiloh. In 1867 he undertook geological exploration in Colorado and Utah and continued this work until 1879 when he became director of the Ethnological Bureau of the Smithsonian Institution. From 1881 to 1894 he also held the position of director of the Geological Survey. His principal writings are *Exploration of the Colorado River, Geology of Uinta Mountains and Cañons of the Colorado*. He died at Haven, Me., Sept. 23, 1902.

POWELL, MAUD (1868-1920), American violinist, was born at Peru, Ill., Aug. 22, 1868. She was a pupil of Dancla in Paris and of JOSEPH JOACHIM in

Berlin. Her début was at London in 1883. After appearing with the New York Philharmonic Orchestra in 1885, she made numerous American tours, and in 1894 organized the Maud Powell String Quartet. During 1899-1905 she made repeated tours, including one to South Africa. She died at Uniontown, Pa., Jan. 8, 1920.

POWER, in mathematics, the result secured by continued multiplication of a number. For example, $5 \times 5 = 25$, and the second power, or square, of 5 is therefore 25. This is indicated by the symbols $5^2 = 25$. Similarly, if $a^n = p$, then p is the n th power of a . With the growth of mathematics the term is now also applied to cases in which n is not a positive integer.

Thus, $4^{\frac{1}{2}} = 2$, and $3^{-2} = \frac{1}{3^2} = \frac{1}{9}$. See **EXPONENT**.

POWER, in mechanics, the time rate of doing **WORK**. The units of power are the **WATT** (one **JOULE** per second) and the **HORSEPOWER** (33,000 foot-pounds per minute). The horse-power is equivalent to 746 watts or .746 kilowatt. The kilowatt equals 1,000 watts.

POWER, SEA WATER. See **SEA WATER POWER**.

POWER AMPLIFIER, any amplifier used in a **RADIO RECEIVER** or **RADIO TRANSMITTER**. As generally used, however, the term is applied only to the final stage of an amplifier, i.e., the one that delivers power to an external system, such as the **LOUD SPEAKER** of a radio receiver or the **ANTENNA** of a transmitting station. Electronic tubes (see **TUBES, ELECTRONIC**) are generally used where amplification is needed.

POWER COMMISSION, FEDERAL, as reorganized by act of Congress approved June 23, 1930, a commission composed of five commissioners appointed by the President with the consent of the Senate of the United States. The Commission itself appoints a secretary, chief engineer, general counsel, solicitor, chief accountant and other employees necessary. All power sites on navigable waters and on United States public lands and reservations are under the control of the Power Commission, which may after investigation construct and operate power projects upon such sites. Irrigation, navigation, flood control and water supply are also to be taken into consideration. All licenses of power developments are subject to a system of public-utility accounting administered by the commission. Annual rental charges are fixed by the commission. It regulates intrastate rates, service and securities where the state itself has taken no action, and interstate business where the states have not the power to act or cannot agree. General inquiries, in cooperation with the Federal or state governments, into power resources and their relation to interstate and foreign commerce, fall under the scope of the commission's work. The results of such investigations are published in special and annual reports. Certain special investigations are required by Congress. S. C. W.

BIOLIOGRAPHY—*Report of the Federal Power Commission, 1931, Commerce and Industry Directory, 1931.*

POWER FACTOR, in electrical engineering, a term employed with **ALTERNATING CURRENT** to ex-

press the ratio of the true watts to the product of the volts and amperes. The term is not used in the case of direct current, since, in circuits carrying non-pulsating direct current, the watts are always equal to the product of the volts and amperes; this peculiarity also obtains in the case of alternating currents when the circuit is non-inductive. But usually, with alternating currents, the current lags or leads the voltage because of the **INDUCTANCE** or **CAPACITANCE** of the circuits or of the machines or devices in these circuits. Designating the angle of lag or lead by ϕ , we have the relation:

$$\text{Power Factor} = \cos \phi = \frac{\text{true watts}}{\text{volts} \times \text{amperes}}$$

POWER GENERATION, ELECTRIC, the production of large quantities of electrical energy by the conversion of other forms of energy. Three principal sources of energy are employed: 1. Large masses of falling water which are utilized to drive hydraulic turbines (*see* **TURBINES, WATER**) coupled to **ELECTRIC GENERATORS**; 2. **COAL, OIL** and **GAS**, which are burned to produce steam for driving steam turbines (*see* **TURBINES, STEAM**) or **STEAM ENGINES** coupled to electric generators; 3. **Oil** or **gas**, which is exploded in **INTERNAL COMBUSTION ENGINES** coupled to electric generators. By far the greater percentage of the electric power is generated at central power stations and transmitted over high voltage lines to substations located in the centers of population and industrial activity. *See also* **POWER TRANSMISSION, ELECTRICAL**; **ELECTRICITY SUPPLY**; **POWER PLANTS**. H. M. H.

POWER IN AGRICULTURE. Power for farming operations is supplied chiefly by man, work animals, tractors, gasoline engines, electric motors, trucks and automobiles, steam engines and wind mills. Steam engines and windmills came into use on farms soon after the Civil War. The gasoline engine was introduced between 1890 and 1900; electricity on the farm, the gas tractor, motor truck, and automobile between 1900 and 1910. The use of work animals reached a peak about 1918 and the stationary gasoline engine about 1920, but the use of electricity, gas, tractor, motor truck and automobile continues to increase. By 1930 mechanical power units supplied approximately 50% of the power used on farms in the United States.

During the human-power era, which lasted until about 1850, from 85-95% of all workers were employed in the production of food. With animal power and the type of machinery available in 1910, only about 33% of all employees were engaged in agriculture. With the aid of mechanical power the number has been reduced to about 21%. *See also* **RURAL ELECTRIFICATION**; **AGRICULTURAL MACHINERY**. W. M. H.

POWER PACK, that part of a **RADIO RECEIVER** which supplies current at the correct potentials to the various parts of the circuit. Power is obtained from the lighting mains. When the supply is **ALTERNATING CURRENT**, the power pack consists of an **ELIMINATOR** and a step-down **TRANSFORMER** which supplies low-voltage current to the filaments of the tubes.

POWER PLANTS, aggregations of machinery whose purpose it is to generate mechanical or electrical power. They may be classified according to the source of power, as: Wind-power plants or **WIND MILLS**; Water-power plants; steam-power plants; and gasoline, oil or gas-power plants.

The total horsepower represented by power plants in the United States is very large, totaling approximately 1,200,000,000 hp., of which about two-thirds represents the transportation industry, including steam and electric railroads, traction and automotive machinery and ships and river steamers. The following table, taken from the report of the Power Division of the American Society of Civil Engineers from the Proceedings of March 1930, shows the detailed use of power-producing apparatus in the United States in its various categories.

Power-Producing Apparatus in United States As of January 1st, 1930.			Horsepower
Central station	steam		30,000,000
	water		15,000,000
	railway		5,000,000
Industrial power	steam		20,000,000
	oil		3,000,000
	gas		3,000,000
Mining			7,000,000
Stationary, not industrial			5,000,000
Steam railway locomotives			135,000,000
Ships			20,000,000
Agricultural and traction			300,000,000
Automotive			650,000,000
Total			1,193,000,000

The force of moving air used in wind mills was probably the earliest development of the power plant and has been used by all nations for at least 1,000 years or more. The total amount of power generated in this type of power plant is rather small and is of decreasing importance.

Shortly after wind mills were invented, the force of falling water was developed in small water-wheel installations. These mills were used for grinding grain and later for driving such machinery as saw mills and ore-stamps for metallurgical purposes. Newcomen, Smeaton and Watt perfected the **STEAM ENGINE** before 1800 and from that time the real power plant had a continuous but slow development until 1882, when the central station for the generation and distribution of electric power established itself. Since then steam-power development has been much accelerated. The **GAS ENGINE**, invented in the early years of the 19th century, sustained a slow development until the opening of the 20th century, when the invention of the gasoline-driven **AUTOMOBILE** opened up a new type of power plant which was to become of enormous importance.

The transportation industry, after using horses and oxen on the land for many centuries, was greatly accelerated by the development of the **LOCOMOTIVE** in the early years of the 19th century, while on the

water the sailing ship began to give way to the steamship about 1830. Gasoline and OIL ENGINES were applied to marine purposes in quantity at the opening of the 20th century and their use in that field has increased enormously.

WATER-POWER plants before 1880 consisted of small water wheels, and they very rarely exceeded a capacity of 1,000 horsepower. From that time the development of the water wheel was quite rapid and now single wheels of over 50,000 horsepower are not uncommon. The latest development is a wheel using from 8,000 to 11,000 cubic feet of water per second, which appears to be near the practical limit in size. In the early hydraulic plants the shaft of the water wheel was connected through gearing with the machinery to be driven. The modern hydraulic plant consists of a water wheel driving an ELECTRIC GENERATOR with its governing mechanism, the power being transmitted over wires to the consumer. See POWER TRANSMISSION, ELECTRICAL. Hydraulic plants are simple in their design but are usually quite costly because of the heavy concrete structures required to handle the water and support the large and heavy machinery.

Steam-power plants in the days of Watt consisted of a crude BOILER and a large and slow-moving engine, the machinery to be driven being connected to the engine shaft through GEARS AND GEARING or BELTS. Early engines made 10 to 20 revolutions per minute and used steam at atmospheric pressure, although some of the followers of Watt soon recognized the value of a higher pressure and used it. The development throughout the 19th century consisted of speeding up the engine, increasing the working pressures and perfecting the details of design. But the year 1900 saw the power plant only a little more complicated than it was in the days of Watt. The power of the engine had been increased from possibly 100 horsepower to 10,000 or 12,000 horsepower for the maximum size, necessitating more than one boiler. The power plant at that time might consist of a battery of boilers connected through a steam main to one or more engines, the power being taken off through the engine shaft and transmitted by belts and shafting to various power-driven machines. The improvement of the ELECTRIC GENERATOR and motor (see MOTOR, ELECTRIC), by THOMAS A. EDISON about 1880, multiplied the convenience and uses of power; electric generators were placed upon the engine shaft and the power was transmitted by wires to motors driving the machines.

The end of the 19th century saw many large-sized steam-engine power-plants, among which the 96th Street Power Plant of the Metropolitan Street Railway Company, New York City, is noteworthy. This plant contained eleven 5,000-horsepower vertical engines driving 3,000-kw. generators. The steam was provided by 87 boilers which were installed on three floors of a boiler house.

About 1903, the commercializing of the steam turbine by Parsons, Rateau, Curtis and Westinghouse

began, and in a very few years had grown to extremely large proportions. The modern power plant consists of a few boilers generating steam at much higher pressures than in the early days and feeding, through the steam main, steam turbines (see TURBINES, STEAM) of sizes varying from 25 hp. to 250,000 hp., the power of which is distributed to the user through electric transmission and distribution systems. The modern power plant using the turbine is a much more complicated affair than the early engine plant or the HYDRO-ELECTRIC POWER plant. The boilers have been greatly increased in size and complexity. SUPERHEATERS, ECONOMIZERS, and air preheaters (see PRE-HEATERS, AIR) have been added; either the coal is fired by STOKERS or pulverized coal, oil or gas is used; boiler pressures have been increased from 200 pounds per square inch to 3,200 pounds; and superheating (see SUPERHEATERS) is used, some of the more modern plants, making the final temperature over 900° F. One experimental plant in Detroit is contemplating generating steam and superheating it to a final temperature of 1000° F. The turbine itself is a complicated mechanism. The regenerative heat systems whereby the feed water is heated (see FEED-WATER HEATERS) nearly to the saturated temperature require heaters and pumps. Heat-saving devices of various kinds are in use all through the system and even the electric generator is artificially cooled by water circulation and the rotor may run in an atmosphere of hydrogen to reduce the wind resistance and cut down mechanical losses.

Industrial plants are found in all sizes and of all designs from the simple old-fashioned plant of one boiler and one engine, generating less than 100 hp., to such plants as the Hell Gate generating station on the East River in New York City, where 800,000 hp. is generated for light and power purposes in New York.

The gasoline-engine power-plant (see INTERNAL COMBUSTION ENGINES) has always been confined to small sizes, although engines as large as 500 hp. have been built for marine purposes. The size of the average gasoline engine, according to the U.S. Geological Survey, is approximately 28 hp., but this one category accounts for about one-half of the total horsepower in use in this country. The AUTOMOBILE power plant is self-contained. The refinement of the gasoline engine has made possible its application to the AIRPLANE. In order to reduce the combined weight of the engine and its fuel for aviation purposes, the parts must be designed to work under stresses very near to the limit, and only the best materials and workmanship can be used. When flying in the upper strata of the atmosphere, turbine SUPERCHARGERS are employed to compress the rarefied air to mix with the fuel. Long-distance and endurance flights have favored the development of air-cooled medium-power engines of 400 to 700 hp., while the utmost requirements of racing machines have produced water-cooled engines capable of developing 2,500 hp. The inherent danger of gasoline during forced landings and the

prospective better economy have stimulated the development of OIL ENGINES, of which a few already have been successful.

Gas-Engine plants were the immediate development from the inventions of Lenoir and Otto and were first used with artificial gas. The earlier engines were quite small in size and it was only after 1890 that these engines were operated with blast-furnace and coke-oven gas, although attempts had been made to run them on producer gas somewhat earlier. See FUELS. Blast-furnace and coke-oven gas engines were built in sizes as large as 5,000 hp., and many thousand horsepower in these engines are in use in the metallurgical plants in the United States. Gas engines resemble a horizontal steam engine in appearance, but are usually very much heavier. One of the best demonstrations of this practice is found in the engine room of the U. S. Steel Company's plant at Gary, Ind., where more than 50 of these engines utilize waste gases from the metallurgical processes.

The OIL ENGINE developed coevally with the gas engine, but was not adopted to any extent until after the invention of the Diesel type. But even then, development was slow and it is only since 1910 that Diesel engines have been built in large numbers. Gasoline-engine plants, gas-engine plants and Diesel or oil-engine plants are very similar in character, differing only in size, fuel used, and other minor particulars.

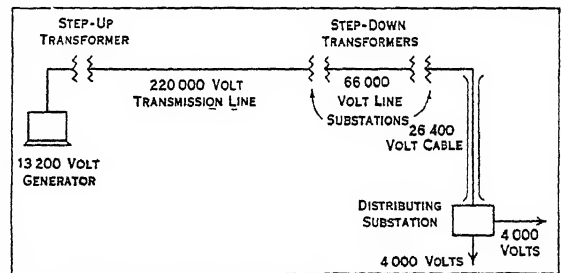
The locomotive power plant has followed the general lines of stationary steam-engine practice. The size of the plant has increased from that of the 10 to 15 hp. "Rocket" of George Stevenson to that of the latest locomotive which develops over 7,000 hp. and weighs about 400 tons. The "Rocket" barely exceeded 10 miles an hour in speed, while modern locomotives pulling long and heavy passenger trains are scheduled at over 60 miles an hour.

The marine power plant has also followed stationary engine practice, but has been specialized because of the lack of space and the necessity for keeping the weight as low as possible. The ordinary steam-engine driven steamship, having passed through the stage of horizontal engines, normally uses a vertical engine of the triple, or rarely, the quadruple-expansion type, while the boilers in common use have been sharply differentiated from ordinary stationary practice. Probably the most popular boiler for marine use is the Scotch Marine internally fired boiler, while stationary BOILERS in equal sizes are almost entirely of the water-tube variety. Turbine-driven (*see* TURBINE, STEAM) ships are quite common, the power being transmitted through gears from the turbine to the propeller shaft, or an electric drive is used, with a generator on the turbine shaft and motors on the propeller shafts. Diesel engines when installed on vessels generally drive direct, although sometimes they are connected to a generator which furnishes current to an electric motor. The river steamers of America followed the early beam engine of Watt with its large cylinder, low-steam pressure and low

speed. Examples of these steamers are running on our eastern rivers today. On the Mississippi River, the stern-wheel type of steamer was developed in which the engine has a very long stroke, a small diameter and drives the stern wheel by means of a long wooden connecting rod. These types, however, are fast disappearing. The Diesel engine began to be installed in vessels around 1910 and has had a rapid development; installations including those on submarine, cargo and passenger vessels. G. A. O.

POWER SHOVELS, a type of EXCAVATING MACHINERY operated by steam, compressed air, gasoline or electricity. The "railroad" type has a "boom" revolving about its base located at one end of the car, with the necessary machinery at the other end. The shovel or dipper is mounted on the end of a "handle" which passes through the struts of the boom and is operated by a rack and pinion. The revolving type of shovel is mounted on a frame which can be rotated; the whole machine being carried on wheels or crawlers. Power shovels excavate hard soil and blasted rock, and are extensively used on large construction work. W. J. D.

POWER TRANSMISSION, ELECTRIC, the transfer of electrical ENERGY in large quantities over considerable distances and at voltages too high for direct applications. Three-phase, 60-cycle ALTERNATING CURRENT transmission is the most common, the



TYPICAL TRANSMISSION SYSTEM

highest commercial voltage being 220,000 volts and the maximum distance 240 miles. The transmission line terminates at a *substation* at the outskirts of a thickly-settled center (*see* figure) where the power is transformed down in voltage and carried underground to a distributing substation at 13,200 and 26,400 volts. *See also* SUPER POWER.

POWER TRANSMISSION, HYDRAULIC, the communicating of power and motion by means of water or oil confined in a container. It has a limited application. Its greatest use is in multiplying the force applied, at a sacrifice in speed, to provide a large mechanical advantage, as in heavy-duty forming and forging presses and hydraulic jacks. Hydraulic power transmission mechanisms may be made to develop a tremendous force, since the resultant force is to the applied force as the area of the liquid at the working end is to the area of the liquid at the end where the force is applied. Thus, if the applied force acts upon one square inch and the resultant

force upon ten square inches, an applied force of 5 pounds will give a resultant force of 50 pounds.

POWER TRANSMISSION, MECHANICAL, the communication of force and motion by the use of levers, cams, screws, gears, chains, ropes, belting, or friction pulleys. Under ropes are included both manila and wire ropes, and chains may be either of the rope or belt types. Leather and fabric belting and gears are probably the most used means of mechanical power transmission. Belt-type chains are widely used in such applications as automobile timing mechanisms.

POWER TRANSMISSION, PNEUMATIC, the communication of force and motion by means of compressed air. It is widely used in PNEUMATIC TOOLS, which are seen on every hand in the form of paving breakers, high speed grinders, small carving chisels and many other tools. There are also such applications as pneumatic hoists and compressed-air paint sprays. Because of its flexibility, compressed air is coming to be one of the most widely used methods of power transmission. One inventor has recently developed a compressed-air automobile engine.

POWHATAN, a confederacy of Virginian Algonkian Indian tribes. Their territory included the tide-water region between the Potomac River and the divide between the James River and Albemarle Sound and extended inland to the eastern edge of the Piedmont Plateau. At first they were friendly toward the white settlers at Jamestown but were driven to warfare by harsh and unfair treatment. The marriage of POCAHONTAS, daughter of their chief Powhatan, to John Rolfe effected a peace which lasted till Chief Powhatan's death in 1618. By the beginning of the 19th century the Powhatans were wiped out due to war with the white men and the Iroquois, pestilence and finally intermarriage with Negroes. The priests and warriors shaved all of the right side of the head with the exception of a small lock over the ear. Polygamy was the custom but depended upon the ability to purchase additional wives and was not extensively practised. A multitude of deities were believed in, and the Powhatans worshipped all forces such as water, lightning, fire and the like, which could harm them. When the English arrived the Powhatan had about 200 villages and numbered about 8,000.

POWNALL, THOMAS (1722-1805), English statesman and scientist, was born at Saltfleetby. He was sent to America in 1753 and again in 1757, this time as Governor of Massachusetts, and later of South Carolina. He returned to England and as a member of Parliament supported the commercial rights of the American Colonies. He was a member of several learned societies. Of his writings on a variety of subjects the most important is *Administration of the Colonies*, 1764.

POWYS, the name of three noted English writers. John Cowper Powys was born at Shirley, Derbyshire, Oct. 8, 1872, and was educated at Cambridge. He lectured on books in the United States with marked success. Among his best known publications

are *Wolf Solent*, a novel published in 1929, *The Meaning of Culture*, 1930, and *In Defence of Sensuality*, 1930.

Theodore Francis Powys, a younger brother, was born in 1875 at Shirley, and was educated at private schools. His writings include *Black Byrny*, 1923, *Mockery Gap*, 1925, *Mr. Weston's Good Wine*, 1928, and *The Only Penitent*, 1931.

The third brother, Llewelyn Powys, was born at Dorchester, Dorsetshire, Aug. 13, 1884, and was educated at Cambridge. From 1914-19 he was engaged in stock farming in Kenya, East Africa, and from 1920-25 in journalism in New York City. His works include *Ebony and Ivory*, 1922, *Black Laughter*, 1924, and *Impassioned Clay*, 1931.

POYNTING, JOHN HENRY (1852-1914), English physicist, was born at Monton, Sept. 9, 1852. Completing his studies at Trinity College, Cambridge, he became a fellow there in 1878. In 1880 he was appointed professor of physics at Mason College, afterward the University of Birmingham. Poynting conducted researches into the density of the earth and magnetic fields, preparing equations to show the flow of energy at a point. He died at Birkenhead, Mar. 30, 1914.

POZNAN. See POSEN

PRADO, THE, at Madrid, a museum of art containing the collections of the kings of Spain. The Royal picture gallery, built in 1785 by Charles III, contains over 2,000 paintings which include the art treasures of Charles V, Philip II, Philip IV and Philip V. The nucleus of the collection was formed by Ferdinand VII who gathered together in the Prado the paintings from the various palaces which housed them. Its chief interest lies in the collection of Moorish and Spanish art. The Prado contains the most effective representation of early Spaniards in the world. Of particular importance is the collection of the works of Velasquez, which included portraits, equestrian figures and many other compositions. There are also many fine Murillos, Riberas, Il Grecos and Goyas.

PRAEFECTURE, the office, or territory, of a praefect of ancient Rome. Praefect was a general term, like chief or commissioner, designating an official appointed by the people, the emperor, or another official. Under the republic certain towns, governed by praefects appointed by the urban praetor at Rome, were called praefectures. The command of various military units, and the control of numerous departments, received that name; the office of Police, or Fire, or Grain Commissioner, was a praefecture. But three appointees of the emperor held especially important praefectures, amounting to ministries, although the incumbent could not be of the senatorial order: these are the praefecture over Egypt, the private domain of the emperor; that over the Praetorian, or Imperial, Guard; and that over the city, or Chief of Police. Under Diocletian (284-305) the entire Empire was divided into four praefectures.

PRAEMUNIRE, STATUTES OF, in England, statutory safeguards against papal interference in the

affairs of the realm. The first such statute, 1353, did not mention Rome by name, but merely condemned to forfeiture and imprisonment anyone who prosecuted suits in foreign courts. The second statute, 1393, was more explicit, specifying the Roman Pontificate. It was used by HENRY VIII against THOMAS WOLSEY, *See also* REFORMATION.

PRAETORIAN GUARD, the special bodyguard of the Roman emperor. Under Augustus it was composed of nine cohorts of 1,000 men each, one of which was always required to be near the emperor. As it was more of an honor to serve in the Guard than in the army, the pay was better and the enlistment period was shorter. The service was voluntary, as against compulsory service in the legions. The proximity of the guard to the city of Rome accounted for its great political power.

PRAGMATIC SANCTION, the declaration in 1713 of the Emperor Charles VI that in the absence of any male heirs his hereditary crowns should pass to his daughter Maria Theresa. It was generally accepted by the sovereigns of Europe, many of whom, however, opposed it later in the WAR OF THE AUSTRIAN SUCCESSION.

PRAGMATISM, a philosophy primarily interested in developing a method for the guidance of life and thought. It is the dominant philosophy of America to-day, and might well be regarded as America's contribution to philosophy. It was Charles S. Peirce (1839-1914) who first formulated it in his method of determining the meaning of ideas by their practical consequences in conduct. Later WILLIAM JAMES developed and popularized the idea. From his standpoint pragmatism was simply "a new name for some old ways of thinking." But it is to John Dewey that credit is due for developing in detail the logic of the school and applying its implications systematically to various philosophical problems.

Pragmatism is essentially humanistic in outlook. It is opposed to absolutism in all its manifestations; the pragmatist abhors an absolute. Its method is instrumentalism. It regards thinking as a means for guiding experience. It is interested in getting the greatest possible meaning out of experience, always on the alert for new experiences. The pragmatic method is a technique for solving human problems, and this method may be applied as rigorously to the values of life as in scientific procedure. Pragmatism thus puts a premium on the ability of intelligence to control experience and sees in such a possibility the only hope for human betterment. It is essentially an attitude toward life and a way of guiding it.

PRAGUE (*Praha*), the capital of Czechoslovakia, situated along both banks of the Vltava River, which reflects its splendid Baroque palaces, spacious monasteries, the sea of houses, the gleam of widespread parks and gardens, and the spires and towers of venerable churches and secular buildings. High above the city, beyond the tiers of tiled mansard roofs, rises the pink silhouette of the Hradčany, the medieval acrop-

olis. Nine bridges span the river, the oldest being the Charles Bridge 1357-1503, with towers and statues, among them that of St. John of Nepomuk. The finest squares are Old Town Square with a monument of John Huss, the St. Wenceslaus Square and the Charles' Place with gardens. There are 48 Catholic churches and 24 chapels, four Protestant churches, a Greek-Orthodox church, 22 abbeys and 10 synagogues, among the latter the Old-New School of the 12th century. Nearby is the old Jewish cemetery with graves of famous rabbis dating back to ancient times. Of the Catholic churches the most prominent is St. Vitus' Cathedral on the Hradčany founded by the Luxemburg emperor Charles IV in 1344. Among the numerous treasures and works of art is the massive silver sarcophagus of St. John of Nepomuk. On the Hradčany is also the Romanesque Church of St. George of 1150. Charles IV founded in addition to the cathedral, a large number of other churches. The Tein Church, built by the Prague merchants, contains the tomb of the astronomer Tycho de Brahe. Of the public buildings, the castle on the Hradčany to which many buildings have been added in the past few centuries is of greatest importance, with its countless halls, chapel, and courts. The old city hall on the Old Town Square also dates from various periods and has a famous astronomical clock. Among the many palaces are those of WALLENSTEIN, the Counts Czernin and the Emperor Ferdinand. Praha is the seat of the Czechoslovak government, an archbishop, of two universities, a technological institute, conservatory of music and many other schools.

The industrial enterprises, chiefly breweries, mills, foundries, textile and machine factories, are mostly located in the suburbs. Emperor Charles IV brought many architects and painters to Praha, and was responsible for the archbishopric and the first university, called the Charles University. The Hapsburg Emperors, Ferdinand I and Rudolph II, also made Praha their residence, the latter calling the astronomers TYCHO DE BRAHE and JOHANN KEPLER to his court. The suppression of the Bohemian Protestant movement in the Thirty Years' War gave place to the erection of the Baroque churches and palaces by famous German and Italian architects. On Oct. 28, 1918, Bohemia declared her independence and Praha became the capital of the Czechoslovak republic. There were 676,663 inhabitants in 1921. Pop. 1930, 848,081.

PRAGUE, PEACE OF, two treaties signed at Prague, the first on May 30, 1635 between the Emperor Ferdinand and the King of Saxony, the second between Prussia and Austria on Aug. 23, 1866. The treaty of 1635 marked a lull in the devastating THIRTY YEARS' WAR. It secured to the elector of Saxony, Lusatia and the archbishopric of Magdeburg. Ecclesiastical estates which had been confiscated before 1555 (Convention of Passau) were to remain forever in the hands of the possessor, all others for 40 years from 1627. There was to be amnesty, toleration for Lutherans only, and joint action against Sweden.

Most of the Protestant states including Brandenburg accepted the peace. The peace of 1866 concluded the SEVEN WEEKS' WAR between Austria and Prussia. It provided for the dissolution of the Germanic Confederation, for the reorganization of Germany without Austria and sanctioned the contemplated annexations by Prussia in north Germany including Schleswig and Holstein. Austria also ceded Venice to Italy, and agreed to pay \$15,000,000 toward the cost of the war to Prussia.

PRAGUE, UNIVERSITY OF, known in Europe as Charles University, at Prague, Czechoslovakia, originally the oldest German university, now divided into a German university and a Czech university. It was founded by Charles IV in 1348, and was modeled largely after the UNIVERSITY OF PARIS, with faculties of law, theology, medicine and philosophy. In 1409, during the Hussite disturbances, the university lost the majority of its German teachers and students, who emigrated to Leipzig. Later in the 15th century it lost both lands and reputation. In 1654 it submitted itself to Jesuit supervision, having previously been united with the Jesuit college of the city. The present Czech unit, which separated in 1882-83 to form its own university, has four faculties, is well equipped, and enrolls annually about 9,000 men and women. The German university has an enrollment of about 3,500 students. In 1930 the faculty of 310 members was headed by Prof. Dr. Jindřich Matiegka.

PRAIRIE, a broad, grassy, treeless plain. The immensely fertile prairielands of the central United States lie between the Missouri and Ohio rivers on the south and southwest, and the Great Lakes on the north. Geologically the region is a peneplain, standing at an elevation of 500-1,000 feet, and deeply veneered with rich alluvial deposits and fine wind-blown dust, called Loess.

The absence of trees greatly facilitated the settlement of the Middle West, necessitating no clearing of the land, so that crops could be raised the first year. The prairies constitute the granary of America, wherein lie the corn belt and the most productive wheat lands.

The treelessness of the prairies is probably due to occasional severe droughts, which would kill saplings although grasses would survive. The summer rainfall of these regions, coming largely from thunder-showers, is usually adequate. When, however, rain fails, as in 1930, vegetation withers, and crops are ruined with disastrous loss.

PRAIRIE CLOVER, the common name for a genus (*Petalostemum*) of herbaceous plants of the pea family. There are about 50 species, natives of North America and Mexico. They are erect, glandular-dotted, mostly perennial herbs with pinnately divided leaves and small rose-colored, purple, violet or white flowers crowded in dense spikes somewhat resembling those of the clover.

PRAIRIE DOG. The three species of this ground squirrel of North America are *Cynomys leucurus* and *gunnisoni*, living chiefly west of the Rocky Mountain

region, and *Cynomys ludovicianus*, the more common, found east of the Rockies. Although prairie dogs thrive as far south as Mexico, they are most numerous in the Great Plains region of the United States. These little rodents, allied to marmots and squirrels, are about 12 in. long, slender, with strong digging claws; they have a curious whistling cry. Their burrows consist of a downward passage, which turns horizontally, opening into dwelling and storage chambers. Outside each is a mound of pressed earth used for observation and to divert water. The animals live on grass and herbage, and often desert their burrows to build nearer a new food supply. Thus prairie dog "towns" are famous for their elaboration and extent, sometimes covering hundreds of square miles. In winter, the animals partially hibernate. Owls, coyotes, wildcats and badgers prey upon them, as do rattlesnakes. With the growth of farm crops and extermination of wild animals, prairie dogs have multiplied and now are fought as pests.

PRAIRIE DU CHIEN, a city in southwestern Wisconsin, the county seat of Crawford Co., situated on the Mississippi River, 98 mi. west of Madison. It is served by river craft and two railroads and a railroad bridge connects the city with Marquette, Iowa. Corn, small grain and tobacco are raised in the vicinity. Woolen goods and wooden ware are the chief local manufactures. The site was visited by Father Marquette in 1673. St. Nicholas, the fort built by the French in 1685, fell into the hands of the British after the French and Indian War, and it was the site of historic Fort Crawford. Prairie du Chien is the seat of Campion College. The city was incorporated in 1872. Pop. 1920, 3,537; 1930, 3,943.

PRAIRIE HEN (*Tympanuchus cupido*), a species of Grouse much prized as a game bird, native to the prairie regions of the Middle West, with barred brownish and buffy plumage and a tuft of long stiff feathers and an inflatable orange air-sac on the sides of the neck.

PRAIRIE REGION, an irregularly shaped lowland province in central United States, bounded by Canada on the north, the Appalachian plateau on the east, the Ozark highlands and Texas hill section on the south, and the Great Plains on the west. It is also called the Central Lowland. The prairie states are Minnesota, Wisconsin, Michigan, Ohio, Indiana, Iowa, Missouri and the western parts of the Dakotas, Nebraska, Kansas, Oklahoma and Texas. The region is characterized by relative lowness and levelness. The boundary between it and the Great Plains is not boldly defined and the differences between the two areas are in rainfall, natural vegetation and agriculture. Except for the northern part drained by the Great Lakes, the prairie region is drained by the Mississippi River and constitutes one of the largest areas of fertile and arable soil to be found in any continent. It also has valuable deposits of iron, coal, petroleum and gas. Originally large parts of the region were overgrown with forests which have mostly disappeared under cultivation. There are also ex-

tensive natural meadows including a long belt of but slightly interrupted prairie extending from western Minnesota and eastern North Dakota south through Nebraska and far into Texas.

PRAKRIT, a group of Indian languages of the INDO-IRANIAN linguistic group spoken from about 300 B.C. to about 1000 A.D. Their direct source was neither Vedic nor classical SANSKRIT, but a dialectic type closely resembling the former. The earliest texts, found in several dialects, are the inscriptions of King Aṣoka; then come the writings of the Jains and the PALI of the Buddhists; next, the Prakrits of the Indian drama (notably Maharashtra, Çauraseni, Magadhi and Pañcāchi); and, finally, several dialects called Apabhraṃṣa, "fallen off, corrupted." Of all these, only Pali, Jaina Prakrit and Maharashtra received extensive literary cultivation. Grammatically the Prakrits resemble classical Sanskrit, though their phonology shows much simplification; and in general they stand to Sanskrit much as the ROMANCE languages stand to LATIN.

L. H. G.

BIBLIOGRAPHY—R. Pischel, *Grammatik der Prakrit-Sprachen*, 1900, A. C. Woolner, *Introduction to Prakrit*, 2nd ed., 1928.

PRASEODYMIUM, a rare metallic element, first discovered with neodymium, in union with which it forms didymium. Praseodymium (symbol Pr) has an atomic weight of 140.9, specific gravity of 6.48, melts at 940° C. and decomposes in cold water. Its principal compounds are a chloride, PrCl_3 ; oxides, Pr_2O_3 , Pr_2O_4 and Pr_2O_5 ; a sulphate, $\text{Pr}_2(\text{SO}_4)_3$ and a sulphide, Pr_2S_3 .

PRATI, GIOVANNI (1814-84), Italian poet and patriot, was born in Dasindo near Trent, Austria, Jan. 27, 1814. His finest work was the blank-verse epic entitled *Edmenegardia*, 1841, on the romantic style of Byron and Lamartine. *Canti Lirici*, 1843, received wide circulation. The patriotic *Albertismo* led to his imprisonment in 1847. Prati has been praised by Carducci for his unusual command of poetical language. In his latter years the poet returned to public life, and died in Rome, May 9, 1884.

PRATO, a city and episcopal see in the province of Florence, north central Italy, on the Bisenzio River. It has encircling walls, a citadel constructed by Emperor Frederick II, a 12th century cathedral completely rebuilt by Giovanni Pisano in 1317-20, with an outside pulpit adorned with reliefs by DONATELLO and Michelozzo. Within the church are frescoes by Fra Filippo Lippi, and Renaissance sculptures. The city has many other churches, a library and a museum. In the 13th century an independent republic, Prato later belonged to Florence, and was stormed by the Spaniards, 1512. The city produces textiles, leather goods and green marble. Pop. 1931, 67,781.

PRATT, BELA LYON (1867-1917), American sculptor, was born at Norwich, Conn., Dec. 11, 1867. He studied at the Yale School of Art, under Saint-Gaudens in New York, and in Paris under JEAN FALGUIÈRE and HENRI CHAPU. Pratt returned to the United States and in 1893 became instructor in model-

ing at the Boston Museum of Fine Arts. He contributed colossal groups to the Water Gate of the Chicago Expositions, decorative panels in the Boston Opera House and figures in the Congressional Library and in the Boston Public Library. His other works include the Soldiers' and Sailors' Monument, Malden, Mass.; *Andersonville Prison Boy*, Andersonville, Ga.; Army Nurses' Memorial, State House, Boston; busts of Phillips Brooks, Bishop Huntingdon and others; and statues of Gen. Stevenson, State House, Boston, and Dr. Coit, St. Paul's Church, Concord, N.H. Pratt died at Boston, Mass., May 19, 1917.

PRATT, FREDERIC BAYLEY (1865-), American capitalist and educator, was born at Brooklyn, Feb. 22, 1865. He was graduated from Amherst in 1887 and became a member of the firm of Charles Pratt and Company, New York. He was president of the Chelsea Fiber Mills and of the Morris Building Company; vice president of The Thrift. He was made president of Pratt Institute, Brooklyn.

PRATT, a city in southern central Kansas, the county seat of Pratt Co., situated on the Ninnesseh River, 82 mi. west of Wichita. Bus lines and three railroads afford transportation. There is a commercial airport. The region produces wheat chiefly, also corn, live stock and dairy products. Flour mills, railroad and machine shops, broom factories and large state fish hatcheries form the leading industries. Pratt was founded in 1884 and became the county seat in 1886. Pop. 1920, 5,183; 1930, 6,322.

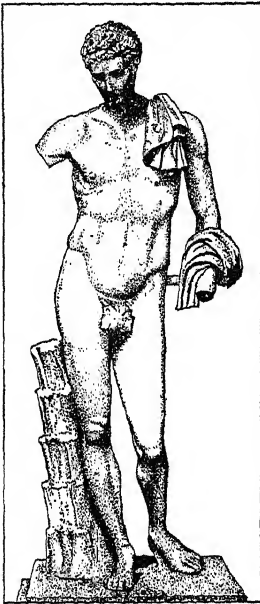
PRATT INSTITUTE, a polytechnical school for men and women, was founded at Brooklyn, N.Y., in 1887 by Charles Pratt. It comprises the schools of Fine and Applied Arts, Science and Technology, Household Science and Arts, and Library Science. Normal courses are given in fine and applied arts and in household science and arts, and evening classes are held. Diplomas are given for completion of the normal courses; but no degrees are conferred. The library of 135,000 volumes contains a large children's room, and is open to the public. The institution has an endowment fund of approximately \$5,000,000 and offers valuable collections of illustrative material for the use of all departments. In 1929-30, the student enrollment in day and evening classes was over 4,500. The faculty was headed by FREDERIC B. PRATT, Chairman.

PRAWN, the popular name for large shrimp-like crustaceans, the most familiar of which are the common American prawn (*Palaemonetes vulgaris*), the common European prawn (*Leander serratus*) and members of a genus (*Penaeus*) numerous in the warmer seas. They vary in size from species some two inches long to species as large as lobsters, such as the river prawn of the West Indies (*Palaemon jamaicensis*). The prawns are usually distinguished from the shrimps not only by their larger size, but also by their possession of a long toothed beak, or rostrum. Most of them are, like shrimps, semi-transparent dwellers on sandy shores. Others, however, live in deep water and are red in color. Some deep

sea species, *Pandalus annulicornis* for example, can eject a luminous smoke screen, presumably to hide itself from its enemies.

Prawns are considered even more palatable than shrimps, and are netted in large numbers on sandy beaches. See also SHRIMP.

PRAXITELES, the greatest of the three immortal Greek sculptors of the 4th century B.C. He worked in marble and bronze, and portrayed a wide variety of



THE HERMES BELVEDERE OF
THE SCHOOL OF PRAXITELES
In the Vatican, Rome

types, with indescribable freshness and charm. One of his originals, mentioned by the Greek writer Pausanias, was found in the German excavation at Olympia in 1877, the *Hermes Carrying the Infant Dionysus*. The *Capitoline Faun* at Rome (the *Marble Faun* of Hawthorne) has been discovered to be copy of a Praxiteles. And the Vatican statue of *Aphrodite of Cnidus*, the *Bathing Venus* of the Capitoline Museum, and the *Venus de' Medici* are all derivatives of the *Aphrodite of Cnidus* of Praxiteles, one of the most admired works of antiquity.

PRAYER, a word signifying the communion of man with God. Prayer may be expressed by an individual in solitude or by a

community in public worship. Prayer may be uttered by the lips as speech or it may be silent, a thought in the mind. The words of a prayer may be spontaneous or they may be derived from a prayer book or liturgy. In public prayer, a reverent attitude, kneeling or standing, is usually adopted.

In all religions, prayer is an element. The Lord's Prayer, beginning "Our Father which art in heaven," or, in Latin, "Pater Noster," is familiar throughout Christendom. It not only consists of a request for what is needed, "Give us this day our daily bread," but includes worship, confession and praise. Written prayers in the Protestant Episcopal prayer book are known as collects.

Since prayer associates man with his Maker who is eternal, Catholics believe that such prayer is not interrupted by mortality. There may be intercession by the faithful on behalf of the departed, and, correspondingly, the faithful may seek from the departed, when beatified or canonized as saints, an intercession on behalf of themselves. Prayer may be assisted by images and idols as expressions of the divine or by particular surroundings. For instance, in China or Japan, it is a custom to pray at the tomb of an ancestor. Prayer may be degraded from the spiritual to the mechanical. In Tibet prayers are

inscribed on paper and enclosed in a cylinder or prayer-wheel which can be revolved by hand, which act is supposed to multiply the efficacy of the petitions so circulated.

PRAYERS FOR THE DEAD. See KADDISH.

PREBENDARY, a member of a cathedral chapter who is entitled to a certain income from an endowment in land or money given for that purpose. In early times the prebendaries were provided with board and lodging, but later received a portion of the church revenue. The clergy of such churches were generally canons and prebendaries at the same time, and the terms are sometimes synonymous. In the Middle Ages there were various other forms of prebends, such as *praebenda mortuaria*, founded for saying masses for the dead. The custom of endowing a CHANTRY belonged to this class.

PRECEDENT, in law, a rule on a point of law by a court of general jurisdiction, or preferably one of appellate jurisdiction. The doctrine of precedents is characteristic of Anglo-American law. Where a point of law has been decided by a tribunal of ultimate appellate jurisdiction it becomes binding upon that court and upon all other courts whose decision that court has power to review as fixing the law upon the point in question. A decision of an inferior appellate court is binding upon the court which rendered it and upon other courts whose decisions it may review, but has only a persuasive authority in courts of co-ordinate rank. In the same way, decisions of the highest courts of one state are only persuasive, not binding, in the highest courts of other states. This doctrine of precedents is often ignorantly inveighed against by those who do not appreciate that when new questions arise they are not governed precisely by precedents, but by legal reasoning on the basis of the whole body of judicial experience of the past. Through the doctrine of precedents, courts in English-speaking countries are able to maintain an effective balance between the need of stability as the basis of the economic order, and the need of change to adjust the law to the changing circumstances of life.

PRECENTOR (Latin *praecentor*, one who sings first, or leads the singing), the director of the singing and music at services in a cathedral or cathedral church. In the English cathedrals of the "Old Foundation," those before the suppression of the monastic chapters, the precentor is a high dignitary of the cathedral chapter, ranking next to the dean, and his musical duties are delegated to a subordinate. In the "New Foundation" cathedrals, the precentor does not belong to the chapter, but is a minor canon. In the Catholic Church the precentor no longer exists as a dignitary, except as an honorary title in some cathedral chapters, though a cleric supervising the services is sometimes so called.

PRECEPTOR, a tutor, or more explicitly one to whom a number of undergraduate students are assigned for help in all matters pertaining to their studies. The Preceptorial System in use at Princeton

University is illustrative. Instruction in philosophy, literature, languages, art, and other subjects is given by means of informal conferences on the assigned work, each student reporting to the same preceptor throughout the course. These conferences are not in the nature of an examination or recitation, but are intended to determine how intelligently the student has grasped the reading, as a method of intellectual stimulation and as a real assistance where the subject may be obscure.

PRECESSION OF THE EQUINOXES, the name given to the very slow westward motion of the equinoxes, resulting from the fact that the axis of the earth during its revolution around the sun does not always keep its direction in space precisely but rotates very slowly around the pole of the ecliptic in about 26,000 years. It is explained as due to the attraction of the sun and the moon on the rotating earth which is not quite spherical in shape, but flattened at the poles. The result is similar to the effect of gravitation on the motion of a spinning top. While the top continues to spin around very fast, its axis slowly describes a cone in space. Precession was known to the Babylonians many centuries before the beginning of our era.

Since the precession makes the axis of the earth rotate around the perpendicular to the ecliptic, the celestial pole changes its place among the stars and describes a circle around the pole of the ecliptic. Not only, therefore, will stars other than the present one become pole stars, but the whole sky will, so to speak, become tilted in time, and constellations disappear below the horizon, while others will appear that are not now visible from our latitudes.

PRE-CHELLEAN CULTURE, the stage of culture which preceded the **CHELLEAN**, at the beginning of the **PALAEOLITHIC PERIOD**, or Old Stone Age. The Abbé Breuil places the Pre-Chellean stage between the first and second glacial intervals of the Pleistocene Period. The Pre-Chellean was a period during which the making of flint implements was still in the experimental stage. The technical art of flaking flint by skillfully directed hammer blows had not yet been mastered, with the result that flint implements of this stage were badly made and of indefinite shapes.

A nodule which happened to resemble a barbed javelin head was chipped to a cutting edge and point, but the tool was so thick that it must have been awkward to handle. Another flint, pointed at one end and flaked to a chisel edge at the other, may have been used in removing the hides of animals killed in the chase. Yet another flint had been roughly chipped so that its edge may have been used to scrape fragments of flesh from hides. See **ARCHAEOLOGY**.

PRECIOUS STONES, a restricted number of **GEM STONES**, valuable because of their rarity, beauty and hardness. They are decidedly harder than quartz, softer gem stones being classified as semi-precious. The precious stones are the **DIAMOND**, **RUBY**, **SAPPHIRE** and **EMERALD**. The diamond is preeminent for hardness, and has a remarkably high refractivity and

dispersion. Consequently, it has great brilliancy and fire. The best stones are colorless, but colored ones are found. The principal source of diamonds is South Africa.

In hardness, brilliancy and fire, the diamond is followed by the ruby and sapphire, both being varieties of corundum, and the emerald. The color of these stones is due to the presence of impurities, and it is for their color that they are valued, as they have little brilliancy or fire. The ruby is a deep red, the sapphire a rich blue. Emeralds are grass green.

The best rubies come from Burma, and the finest sapphires from Siam. Colombia produces the best emeralds. See also **MINERALOGY**.

PRECIPITATION, the name given in meteorology to all condensation and deposit of the water vapor from the atmosphere, whether liquid or solid. Its principal forms are **RAIN**, **HAIL** and **SNOW**, with their varieties such as soft hail and **SLEET**. **Fog** and **MIST** are the transitional stage between rain and a cloud, as in this case the waterdrops are small, and fall very slowly. **Dew** and **Frost** are not precipitation in the sense that they do not fall from the sky; instead they are formed on the surface of objects near the ground.

PRECIPITATION, in chemistry, the separation of a solid from another substance in which it is in solution, so that it falls to the bottom in insoluble form. Methods of producing precipitation include. the addition of reagents which form an insoluble compound with the material or displace it from the solution; coagulation through the application of heat; change of temperature; **CRYSTALLIZATION**; **SALTING OUT**.

PRECISION TOOLS. Precision has no positive definition. In some classes of work $\frac{1}{32}$ of an inch is perfection, while in others half a thousandth is everyday practice. Generally speaking, precision tools are machines that can be depended upon to give uniform accuracy of the required degree in their day to day production. In many cases machines that cut with tools or cutters do not attempt to give the final accuracy to the work but only rough it for the final grinding finish. (See **GRINDING MACHINES**.) This rough machining is, however, more accurate than many finishing operations of 20 years ago. In the last analysis, precision and accuracy are but comparative terms. Precision instruments are in the same class and refer to methods of measuring the accuracy of the work done. For the finer work, mechanical methods have been replaced by optical methods of measurement and variations as small as a hundred thousandth of an inch can be readily detected. F. H. C.

PREDESTINATION, as a doctrine of Christian theology, means the decree of God from eternity respecting all events, especially the foreordination of men to eternal happiness or misery. It is related to the conception of Fate as understood by the Greeks and of Necessity as taught by the Stoics, and might be expressed as the opposite of the Epicurean doctrine that there is no divine superintendence of

human life. Because of its entanglement with the problem of free will, theologians have divided on the question without solving it. Twice in Christian history it has separated large bodies of believers. In the early centuries it divided the followers of Pelagius and Augustine and after the Reformation it separated the Calvinists and the Arminians. As modern theology has moved away from the old battlegrounds, the creedal statements, though retained by many of the churches, are less emphasized.

PREFECT (Latin *praeffectus*), the title of various high officers at Rome, as the prefect of the city, who was appointed in the absence of the Consuls; the prefect of the praetorian guard, of the treasury, the grain, the police. Also the prefect of Egypt, the imperial governor, representing the crown; and the municipal prefects who were appointed by the emperor, and were an important link in the destruction of municipal local self-government. In modern French government the prefect is an official in charge of internal administrative functions.

PREFERENCE, IMPERIAL. See **IMPERIAL PREFERENCE**.

PREFERRED NUMBERS are mathematically related numbers forming a series from which dimensions are selected for serial sizes of any commodity, thus avoiding irregular and illogical size increments. A geometric series has been found most practical after extensive application in Europe. In 1927 an American committee recommended four such series, of 5, 10, 20 and 40 terms respectively, ratios between successive terms to be $\sqrt[5]{10}$, $\sqrt[10]{10}$, $\sqrt[20]{10}$, and $\sqrt[40]{10}$ respectively. In a series of 10 dimensions, for example, each dimension would be 1.259, ($\sqrt[10]{10}$), times preceding dimension. E. W. E.

BIBLIOGRAPHY.—*Table of Preferred Numbers*, published by American Standards Association.

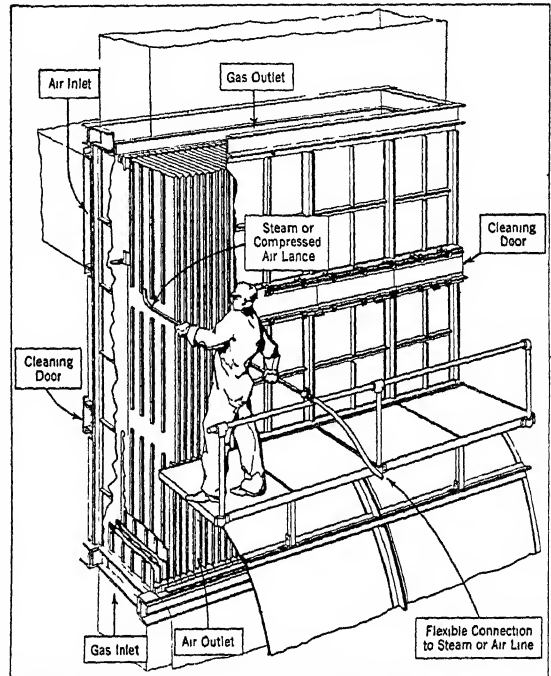
PREFERRED STOCK, that portion of the Stock of a corporation which has a claim upon earnings and dividends ahead of the common or other class of stock. As a rule its dividends are at a fixed rate, usually from 6 to 8% on industrials and 4 to 7% on railroad stocks. This class of stock has the characteristics of both a stock and a Bond but it is not a debt of the corporation and the omission of a dividend does not constitute insolvency. It represents an equity in the corporation which ranks after all bonds and floating debt but ahead of Common Stock. Dividends must be paid on preferred stock before any distribution to the common stockholders. Sometimes such stock is issued in series, such as Preferred A and Preferred B or First Preferred and Second Preferred in which case dividends must be paid on the first series before the second. Dividends may not be paid on common stock while those on the preferred are in arrears. Such preferred dividends may be cumulative or non-cumulative. Cumulative dividends, if not paid in one year, carry over from year to year until paid and become a claim on earnings, from which dividends may not be paid on the common stock so long as the cumulative dividends on the preferred remain unpaid.

The courts have held that dividends upon preferred stock are cumulative unless otherwise stated. Usually preferred stocks have no vote.

PREGNANCY: Care during. See **OBSTETRICS**; **MATERNAL AND INFANT WELFARE**. Eclampsia in. See **ECLAMPSIA**. Vomiting of. See **DYSPEPSIA**.

PRE-HEATER, AIR, a device which recovers part of the heat in the escaping flue gases of a furnace and utilizes it to heat the air which is to be used for the combustion of the fuel, to supply warm air for industrial processes, or to heat buildings.

Air pre-heaters are divided into two general classifications: 1. Regenerative and 2. Recuperative. A regenerative heater is one in which air is heated by



COURTESY INTERNATIONAL COMBUSTION ENGINEERING CORP.

C E AIR PREHEATER

contact with masses of metal or refractory materials previously heated by hot gases. The alternate heating of the air and cooling of the gases may be carried out as a continuous or an intermittent process, depending on the construction of the heater employed. It is thus evident that regenerative heaters require the manipulation of dampers, valves or heating surface. Therefore, the presence of moving parts is a characteristic of this type of heater.

The *Lyngstrom* heater is of the rotating regenerative type. It consists essentially of a steel rotor filled with thin corrugated plates, forming a honey-comb construction. The heater casing is divided into two sections by vertical partition plates. The hot gases enter one section of the casing and pass through the rotor, heating it. The rotor is revolved slowly and passes to the cold section of the casing where it gives up its heat to the incoming cold air. In like manner the cooled part of the rotor is returned to be

heated by the hot gases. The operation is thus continuous.

A recuperative heater is one in which the heat flows from the hot gas to the relatively cooler air by conduction through an intervening metallic wall. Heaters of this type are characterized by the absence of moving parts. Heaters of the plate and tubular type are operated on the recuperative principle.

The *C.E.* air pre-heater is of the plate type and is composed of a number of elements placed side by side in a casing. The individual elements are made of two steel plates electrically welded together at their edges. An opening is maintained between elements by spacer bars. In this type of heater the gases flow on the outside, while the air flows in the opposite direction on the inside of the elements. This pre-heater is shown in the figure.

In the *tubular* type heater the hot gases usually flow through the tubes while the air passes around them. Two tube sheets are provided, the tubes fitting just loosely enough in one of them to permit expansion and contraction. The heaters are set vertically, the gases passing either upward or downward. The air has a combination of counter and cross flow.

O. DE L., K. T.

PREHISTORIC MAN. The terms Prehistoric or Fossil man define the human stocks living in the geologic ages preceding our own, the Pleistocene and possibly the late Pliocene, the periods of the great glaciations. The frequently used "Paleolithic" refers to the culture of fossil man.

The scientific world places man and the anthropoid apes, including the gibbon, orang-utan, chimpanzee

support of a fully erect posture. From the days of Darwin, we have awaited the discovery of the "Missing Link," a creature in all physical characters halfway between man and the anthropoids. We still wait, but year after year adds knowledge of fossil beings which, though they may not fulfill the requirements for an undisputed ancestor of modern man, are definitely nearer the apes than we are. In spite of a few contradictory traits, the finds of fossil men when ranged according to geologic time are also aligned according to simian likeness.

LATE PLIOCENE OR EARLY PLEISTOCENE AGE

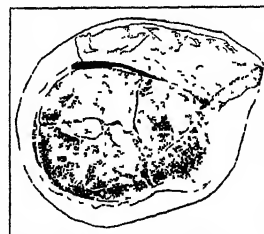
Geologically earliest and anatomically most ape-like is the fossil known as *Pithecanthropus Erectus* found in the island of Java by Dubois, 1891, in deposits of very late Pliocene or earliest Pleistocene age. The skull, low, with receding forehead and heavy bars of bone above the eyes, has a capacity of about 900 cubic centimeters, a brain size intermediate between that of the largest apes and the smallest modern man. Accompanying this skull which alone might have been considered that of a large ape was a thigh bone so perfectly human that the specimen was named The Ape-Man Who Stood Erect. Three molar teeth conforming to those of modern primitive men also bore out the theory that certain parts of *Pithecanthropus Erectus* had evolved far from the anthropoid origin while the skull and brain had lagged behind.

Sinanthropus, the Peking Man, stands close to *Pithecanthropus* in geologic time and in physical type. Found in the very early Pleistocene cave deposits of Chou Kou Tien by Davidson Black, 1929, the age of this discovery is indisputable and the remains of several individuals make it perhaps the most important find of prehistoric man. Two skulls, two lower jaws, and a large number of



COURTESY AMER. MUS. OF NATL. HISTORY

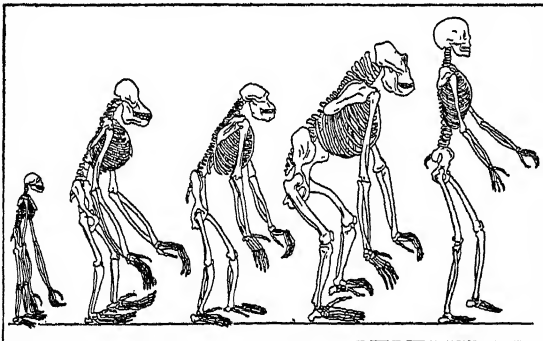
SKULL OF THE PEKING MAN
Second specimen of *Sinanthropus pekinensis* found July 28, 1930



COURTESY AMER. MUS. OF NATL. HISTORY

CAST OF THE SKULL OF
SINANTHROPUS

isolated teeth tell the type of the China Man of 250,000 years ago. Like the Java fossil *Sinanthropus* had a low, flat skull with brow ridges even heavier and more outstanding. The fullness of the frontal and parietal regions, however, suggests somewhat greater humanity, but the estimated cranial capacity is only about 1,000 cubic centimeters below the average for even the Australian aborigines. From the form of the teeth, the lower jaws and the region of the skull which surrounds the ear, tendencies away from the ape and in the direction of modern man are evident.



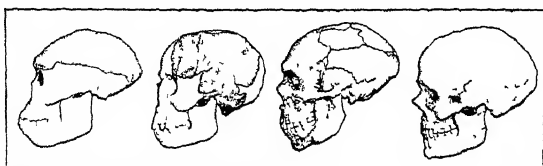
FROM WILSON D. WALLIS AN INTRODUCTION TO ANTHROPOLOGY. COURTESY HARPER & BROS

MAN AND THE MANLIKE APES

A redrawing of the old figures first used by Thomas Henry Huxley

and gorilla, in the same zoological class, the PRIMATES. In all parts of the skeleton, the muscles, nerves, viscera, dentition and other bodily characters, man differs less from the great apes than do these anthropoids from the lower monkeys. Anthropoid apes belong to the same blood groups as man; they are susceptible to the same diseases; their mental processes differ in degree rather than in kind. The trait that sets man off from any other member of the common primate stock is his large and complex brain. Second in order of humanity is the foot with its adaptation for the

In deposits of the same glacial age, the early Pleistocene in England, Charles Dawson found in 1911 the famous Piltown Man, *Eoanthropus Dawsoni*. The size and contours of the skull with its smooth forehead and brain capacity of 1,300 cubic centimeters is fully though primitively human. The cranial bones, however, are enormously thick and the accompanying lower jaw, chinless and with a canine projecting



COURTESY AMEP MUS OF NATL HISTORY

RESTORATIONS OF THE SKULLS OF PREHISTORIC MAN

Left to right *Pithecanthropus*, *Piltown*, *Neanderthal*, *Cro-Magnon*

above the borders of the other teeth, is distinctly simian. Numerous scientists still argue over the ownership of skull and jaw by the same individual. It seems more reasonable that, instead of chance depositing the skull of a fossil man and the jaw of a fossil ape together in the Piltown gravel pit, we have again, as with the thigh bone and brain case of *Pithecanthropus erectus*, and the skull and teeth of *Sinanthropus*, a tendency to asymmetry in the evolution of human types.

The massive, chinless mandible of Heidelberg Man presents another contradiction in evolutionary position, discovered by Schoetensack, 1908. In this otherwise bestial jaw, the teeth are arranged just as in modern man. They differ, however, in the remarkable expansion of their pulp cavities and in the shortening of their roots. No other part of this fossil from the early Pleistocene sands of Mauer, Germany, was unearthed.

ACHULEAN TO MOUSTERIAN PERIOD

From Germany also and of a somewhat later period are the finds near Weimar, the Taubach teeth, unearthed in 1891 and 1915, and the Ehringsdorf skull found by Weidenreich, 1925. These are the oldest human remains associated with stone implements of datable age. Implements and animal remains are of the Achulean period, the second, universally recognized stage in paleolithic industry. The Ehringsdorf skull, large brained with a probable capacity of 1,480 cubic centimeters, is the oldest specimen of the well-known fossil race of Neanderthal, elsewhere always associated with Mousterian implements and Middle Pleistocene fauna.

Our knowledge of Neanderthal Man is surer and vastly more extensive than of the preceding fossil types. From clearly dated cave deposits, we have the remains of at least 50 individuals, including several nearly complete skeletons of men, women and children. The discoveries range in space and time from the Gibraltar skull found in 1848 to the child unearthed in 1931 in a cave of Palestine. The Neanderthal race has been found as far west as the Channel

Islands, in Spain, France, Belgium, Germany, Hungary, the Crimea and Galilee. So widely do the skeletons of these men differ from all modern stocks that the scientists of 1848 considered the Gibraltar skull the result of individual pathology and it was a later find made in the Neanderthal near Dusseldorf, Germany, in 1856 that named the race. The characteristics of Neanderthal man have been presented and interpreted in masterly fashion by Professor Marcellin Boule of Paris. The head of Neanderthal man was very large with the face greater in proportion to the brain size than in modern man. The skull, very flat with huge brow ridges and protuberant back, the snout-like jaws and enormous round eye sockets, the heavy chinless jaw with big teeth similar to those of Heidelberg Man gave an appearance of bestiality. The brain, however, is that of man. The mean cranial capacity, 1,450 cubic centimeters, is the average of various modern groups. The cerebral conformation shows some primitive characteristics. The Neanderthal children and modern European children resemble each other much more closely than do the two adult stocks. Neanderthal adults were short with heavy bones, and various traits of arms, legs and vertebral column suggest that their posture was not completely erect but somewhat stooping. It is generally considered most unlikely that so primitive and aberrant a type is ancestral to modern man with whom he must have been contemporaneous at least in western Europe. With the end of the Mousterian culture period, the race vanished.

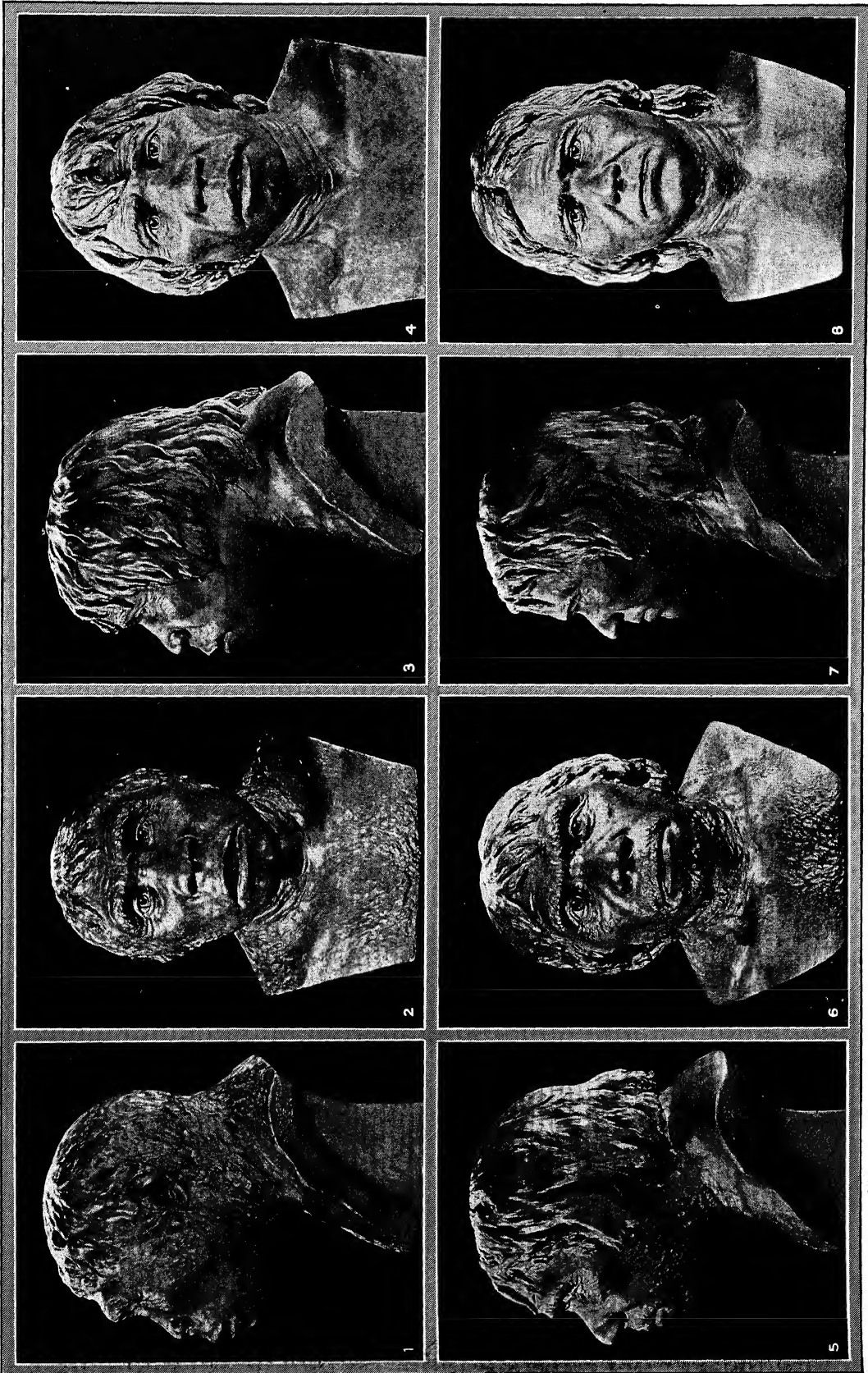
The most strikingly Neanderthaloid specimen yet found outside of Europe and the Near East is the Rhodesian or Broken Hill Man, discovered in 1921. In nearly all traits, this skull is identical with those of the European Middle Pleistocene. The teeth are completely human, even to caries, and the position of the vertebral column shows that the Rhodesian Man stood fully erect. The skull cannot be dated either by geological or paleontological remains. The bones are not fossilized and this fresh state suggests that in a corner of Africa, a Neanderthaloid stock may have survived until present geologic times. Another early African man is the Boskop skeleton from the Transvaal. The bones are heavily mineralized but there is no further evidence of its age. The skull is extremely flat with certain simian characters, and a generalized negroid form.

In Australia, two highly fossilized skulls have been found in Queensland and Victoria. The Talgai and Cohuna men are attributed to the Pleistocene period on the basis of this mineralization. Both differ from the Australian aborigines, the most primitive of living races, in degree rather than in kind. They are lower, more brutal, with great palates, huge teeth, and faces elongated into snouts. A similar type is the Wadjak skull from Java.

UPPER PALEOLITHIC CULTURE

Long before Pleistocene times ended modern man appeared in Europe. During the last cold phase, the

PREHISTORIC MAN



PHOTOS FROM RESTORATIONS BY DR. G. H. MC GREGOR, COURTESY AMERICAN MUSEUM OF NATURAL HISTORY

HEADS OF PREHISTORIC MAN, RESTORED FROM SKELETAL SURVIVALS

- 1, 2. Pithecanthropus, side and front views. 3, 4. Pittdown man, side and front views.
5, 6. Neanderthal man, side and front views. 7, 8. Cro-Magnon man, side and front view.

age of the reindeer and of upper Paleolithic culture, *Homo Sapiens*, big-brained, tall, in all traits completely human, supplanted the short, stooped simian man of Neanderthal. The term Cro-Magnon has been applied generally to fully modern physical types living in Pleistocene times. Specifically, it refers to the type first found in 1868 near the village of Cro-Magnon (Dordogne), France. Typical Cro-Magnon man is characterized by a long, narrow, relatively high skull of a brain capacity somewhat greater than the present European average, a short wide face, a heavy jaw with a prominent chin and stature just under 6 ft. Skeletons of this type have been found in Wales, southern France, Germany and Czechoslovakia. The caves of Grimaldi on the border of France and Italy, explored by Verneau, 1906, and the Moravian loess site of Predmost have contributed the largest groups of Cro-Magnon men. Unlike Neanderthal man, however, the general term Cro-Magnon covers a variety of forms as great as we find in any present European country. There are the short, Eskimoid type of Chancelade, the Grimaldi and Combe-Capelle skeletons suggesting negroid traits, the beginning of a rounder, shorter head form in the recent Aurignacian finds at Solutre.

Just as the old Pleistocene times ended, when modern forests and modern fauna begin in Europe but before the introduction of agriculture and domestic animals, the last group of fossil men appear. The people of the Transition period were of short stature with relatively small skulls. The burial sites in Ofnet, Bavaria, Mugem, Portugal, and in Montardit, French Pyrenees, and various spots in Great Britain have yielded long and narrow, medium, and short and broad skulls often from the same graves, a mingling of types in one locality not found in the earlier periods.

Africa and Asia Minor have also given up skeletal remains attributed to Upper Paleolithic man. In Kenya, Tanganyika Territory, the Northern Transvaal and the vicinity of Cape Town finds have been assigned largely on the basis of fossilization to various of the culture stages found in late Pleistocene Europe. The East African men are tall with big brains, long faces and heavy jaws, suggesting strongly a negroid type. The South African (Fish Hoek) man is similar to the modern Bushmen. These perhaps may be considered as ancestral to the present Hamitic and Bushmen peoples as the Cro-Magnon race is ancestral to the modern European. The men of the later deposits in the Palestinian caves of Shukbah and Mount Carmel, discovered in 1929-30, strongly suggest that slightly negroid branch of the modern Mediterranean race which was represented by the predynastic Egyptians. Fossil man has been found on all the great land masses except the Americas. Europe has given us an unbroken series from very early Pleistocene times: the primitive Heidelberg and Piltown, the pre-Neanderthal of Ehringsdorf, the bulk of our present knowledge of the Neanderthal race, the long and varied series of Cro-Magnon remains, and the short, round-

headed men of the Transition. Asia, as yet little explored, has shown on one border the two most primitive beings, *Sinanthropus* and *Pithecanthropus Erectus*, and on the other, the Galilee Neanderthal and the late Paleolithic men of the Palestine caves. From Africa has come the Rhodesian man, cousin to the Neanderthals of Eurasia, the ancient Boskop skull, and the old though undatable remains from Fish Hoek, Oldoway, Kenya and Springbok. The Australian skull from Cohuna, Victoria, is considered by Sir Arthur Keith to represent—with the exception of *Pithecanthropus* of Java, the Peking man, and perhaps, Piltown—the most primitive human form known to us.

Where, then, did man originate? No specimen so far discovered could be parent to all the other fossil men. The asymmetrical distribution of simian and human traits in each type precludes that possibility. Nor is there any that can qualify as the certain ancestor of modern man. Moreover, two types of very different evolutionary status have been contemporaries on the earth. The lowly Peking Man of China and Piltown Man of England with its human brain probably evolved in the same period; in France, the modern men of Grimaldi and the race of Neanderthal must have been near neighbors. In more than one spot at more than one time, various species of man have been differentiated from the early human stem. It seems more likely that man has arisen in those places where the great anthropoids, his nearest kin, have also evolved. The present distribution of the gibbon is southeastern Asia and the island of Sumatra, the orang-utan is limited to Sumatra and Borneo, and the habitat of the chimpanzee and the gorilla is west equatorial Africa. Like man, the modern anthropoids had their precursors, and the remains of these fossil apes are spread over a wider range than are their descendants. Egypt, Southern France, Tuscany, Central Europe and Greece have all been the graves of Oligocene and Miocene primates. Several specimens have been found in the Siwalik Hills of northern India. At Taungs in South Africa there was discovered in 1924 the most humanoid of the extinct apes. Europe, Asia, Africa, all have been the homes of fossil or living apes; each continent has produced remains of more than one type of fossil man. Australia and the Americas are left. The primitive Cohuna and Talgai skulls are so closely related to the Wadjak man of Malaysia as to suppose a common origin.

PREHISTORIC MAN IN AMERICA

The question of the presence of prehistoric man on the American continent has been disputed long and violently and is still a matter of discord among the leading authorities on fossil man. The controversy concerns the possibility of a type of early man having originated in North or South America and the date of arrival of man from Asia, the generally conceded habitat of the Mongoloid invaders. Dr. Hrdlicka of the United States National Museum denies definitely the possibility of the Pleistocene occupation of Amer-

ica. Sir Arthur Keith is almost certain that in Pliocene and Pleistocene times man crossed Bering Straits and that his fossil remains will yet be found in America. Professor Boule feels that man could not have crossed from Asia during a glaciation. This would not, however, necessarily postpone the arrival until the final retreat of the glaciers but also sets the possibility within an interglacial period. The enthusiasm which led the late paleontologist Ameghino to place the origin of all mankind in the pampas of South America died with him. The facts on which these theories are built are few and largely negative. No anthropoid ape fossil or living and only one fossil monkey has ever been found on the American continent. In North America, no human skeletal remains have been found in Pleistocene deposits under conditions better than equivocal. The fact that all skulls found in doubtful sites resemble closely the American Indian is less fundamental. It is the presence of the stone industry of Trenton, N.J., which most clearly points to very ancient human occupation, at least at the beginning of present geologic time. Leaving out the extravagances of Ameghino, it is not impossible that some of the human remains from the Argentine pampas may go back to the Pleistocene. The skulls from the Brazilian caves near Lagoa-Santa, discovered in 1844, and the fossilized specimen of Australoid type from Punin, Ecuador, found in 1923, denote a certain antiquity to man in South America. See also ANTHROPOID APES; EVOLUTION; PRIMATES.

R. S. WA.

BIBLIOGRAPHY—M. Boule, *Les Hommes Fossiles*, 2nd ed., 1923; G. E. Smith, *The Evolution of Man*, 2nd ed., 1927; Sir Arthur Keith, *The Antiquity of Man*, revised ed. 1929, and *New Discoveries Relating to the Antiquity of Man*, 1931; A. Hrdlicka, *Skeletal Remains of Early Man*, 1930; E. A. Hooton, *Up from the Ape*, 1931.

PREHISTORY. See ARCHAEOLOGY.

PRELATE (Latin *Praelatus*, preferred, from *praeferre*, to prefer), in the Catholic Church the occupant of a high ecclesiastical position with jurisdiction. Prelates are primarily bishops, but may also be abbots. Roman prelates are the high officials of the Papal Curia after the cardinals. "Domestic prelate" and "honorary prelate" are titles for prominent divines who assist personally at papal religious functions or who have been honored for their labors for the Church. *Praelatus nullius* (Greek *dioceseos*) is an exempt abbot who has episcopal jurisdiction over his abbey, or also over parishes belonging thereto. Protestant ecclesiastical dignitaries in the Anglican Church have the title of prelate as have those in Sweden, Denmark and some parts of Germany.

PREMONITION, a warning in the shape of a sign or feeling of impending disaster. It is a common occurrence as a sense of uneasiness or apprehension. The belief in its prophetic character is widespread, and rests largely on noting favorable and disregarding unfavorable instances. The serious investigation of such relation appears in PSYCHICAL RESEARCH.

PREMONSTRATENSIS, or NORBERTINES (in England, White Canons), an order of

canons regular founded at Prémontré, Aisne, France, by St. Norbert in 1120. Embracing the Augustinian Rule, they combined the monastic with the canonical life. The growth of the order in Europe and Asia in 200 years was prodigious, but irregularities within communities, and political and religious upheavals took their toll. The early 20th century, 1900-30, witnessed a new development, the order numbering 5 provinces, 42 abbeys and 1,933 members (priests, clerics and lay brothers), established in nearly every European country, in the Belgian Congo and Madagascar, England, Canada, the United States and Brazil. There are also convents of nuns, Second and Third Orders of St. Norbert, and of the Congregation of Norbertine Sisters.

PRENDERGAST, MAURICE BRAZIL (1861-1924), American landscape painter, was born at Boston, Mass., in 1861. He studied at the Julian Academy in Paris. For several years he settled in Boston, but moved to New York in 1914. He was awarded a medal at the Corcoran Art Gallery, Washington, D.C., in 1923, for his *Landscape with Figures*. Other works are *Crepuscle*, *Chrysanthemum Market*, *On the Cliffs*, *The Merry Maidens* and *Seashore*. Prendergast died in New York, Feb. 1, 1924.

PRENTICE, GEORGE DENISON (1802-70), American journalist, was born at Preston, Conn., Dec. 18, 1802, and graduated in 1823 at Brown University. In 1830 he established the Louisville, Ky., *Journal*, a Whig paper, which became a political force in the community. Prentice's editorials opposing secession were influential in restraining Kentucky's withdrawal from the Union. He died in Louisville, Jan. 22, 1870.

PREPARATORY SCHOOLS, secondary schools which have developed their curriculums with the definite purpose of preparing students to meet the entrance requirements of universities. These schools may be private institutions or a part of the public school system. The greater number of private secondary schools would come under this classification, while in the public high schools preparation for college is only one of the functions. The earliest preparatory schools in America were the Latin grammar schools for boys. Following these came the academies, some being open to girls. The tendency in private schools since the days of the academies has been to have separate schools for boys and girls.

PRE-RAPHAELITISM, in painting, a reform movement begun in England in 1848 by DANTE GABRIEL ROSSETTI (1828-82), Holman Hunt (1827-1910) and JOHN MILLAIS (1829-96); joined later by William M. Rossetti and the three young sculptors, Frederick G. Stephens, Thomas Woolner and James Collinson. This strongly individualistic little group, valiantly championed by JOHN RUSKIN, had a strong and far-reaching influence on the art not only of England but of the Continent, through their fervid zeal to throw off the conventionalized "Raphael tradition" and restore the naïve simplicity and attractiveness of the ITALIAN PRIMITIVES. Rossetti was most closely identi-

fied with the medieval spirit of the 13th and 14th centuries associated with this movement. Poet as well as painter, he was steeped in the mysticism of Dante. The stark realism of Courbet made no appeal to him; he painted as he wrote, in a mystical, romantic spirit in terms of feeling and design. His influence on the movement was offset on the one hand by the Puritanism and religious fervor of Holman Hunt and on the other by the materialism and high technical standard of Millais. But on the early work of all three there was the characteristic Pre-Raphaelite stamp of minute imitation of nature down to the smallest detail. Other noted artists closely associated with the movement were Ford Madox Brown, EDWARD BURNE-JONES, Arthur Hughes, Spencer Stanhope, Albert Moore, Walter Crane and WILLIAM MORRIS. Through the last two a new impulse was given to decorative art. Poetry went hand in hand with painting in this movement, many of the painters being even better poets. Swinburne, the poet, formed one of the group. The significance of this and other art reforms of the middle of the 19th century can be rightly viewed only as part of the great wave of revolt against artificial authority and barren dogmas which surged through Europe at that time.

PRE-RAPHAELITISM, in English poetry, a movement or esthetic tendency, originating in about 1850, born of a desire to endue modern poetry with the sincere spirituality, the simplicity, the sensuousness and the high regard for form which had marked the work of the primitive painters. The Pre-Raphaelite group, centering around Dante Gabriel Rossetti (1828-82), his sister, Christina Rossetti (1820-94), and William Morris (1834-96), first tried its fragile wings in the short-lived periodical *Germ*, 1850, later continuing its flights in *The Oxford and Cambridge Magazine*, 1856. Much as they have been criticized for the esoteric flavor of their work, the founders of the group produced some poetry of lasting value: for example, D. G. Rossetti's *Blessed Damsel*, *Sister Helen* and *The House of Life*; Christina Rossetti's sonnets and lyrics of unearthly love; and Morris's *Defence of Guinevere*, *Jason*, *The Earthly Paradise* and *Sigurd the Volsung*. See also ENGLISH LITERATURE; separate articles on above authors.

BIBLIOGRAPHY.—H. A. Beers, *A History of English Romanticism in the Nineteenth Century*, 1901, G. Saintsbury, *The Later Nineteenth Century*, 1907; *The Cambridge History of English Literature*, 1907-17; T. E. Welby, *The Victorian Romantics*, 1929.

PRERAU. See PRĚROV.

PRĚROV (*Prerau*), Czechoslovak city in Moravia. It has an old castle with a tower, a Gothic city hall and a monument to A. Comenius, the great Czech pedagogue and bishop of the Moravian Brothers. There are schools for higher education and vocational schools. The manufactures include metal goods, machines, paints, fertilizers, rope, sugar and other goods, in which there is an active trade. Pop. 1930, about 24,000.

PRE-SABELLIAN or **PICENIAN, LIBURNIAN**, an extinct language preserved in a few se-

pulchral inscriptions chiefly from the territory of ancient Picenum in Italy. They are written in an archaic form of the North Etruscan alphabet in lines running alternately from left to right and from right to left ("boustrophedon"), but many of the readings are uncertain, and the texts have not definitely been determined. The linguistic affinities of Pre-Sabellian are not yet wholly clear, though it may belong to the ILLYRIAN group. L. H. G.

PRESBYTER (a Greek word, meaning Elder), the name of the head of an early Christian community. Following the example of the Jewish synagogues, elders were endowed with a certain authority in the churches in Palestine. Those converted from heathenism followed the same custom, as with them, too, the elders enjoyed special honors. The presbyters were in charge at divine service, and administered all the affairs of the parish with the assistance of DEACONS. They also supervised the moral life of their flocks. During the 2nd century the presbyters were subordinated to the bishops. After the 4th century the presbyters lost their original prominence, but retained their liturgical office, the right of administering sacraments, of preaching and of teaching, but all by delegation of the bishop. They became pastors of single churches in the bishop's diocese, priests in the usual sense. It was the Reformers who interpreted the dignity of presbyter as a lay office. This was especially true in the case of the Calvinists, with whom the presbyters and the divines, both elected by the congregation, formed a body, the Presbytery, having far-reaching powers. In Geneva the presbyters had the duty of supervising the lives of the members of the parish and, together with the clergy, exercised ecclesiastical discipline in the consistory.

PRESBYTERIAN CHURCH. In doctrine the fundamental principles of the Presbyterian Church rest on the undivided sovereignty of God in His universe, the sovereignty of Christ in salvation, the sovereignty of the Scriptures as the only infallible guide in faith and conduct, and the sovereignty of the individual conscience in the interpretation of the Word of God. In its polity the Presbyterian Church recognized Christ as the only head of the Church and the source of all power, and the people of Christ as entitled under their Lord to participate in the government and action of the Church.

Membership in the Presbyterian Church is based on the simple acceptance of Jesus Christ as Lord and Saviour and a promise to seek to live the Christian life. The government of the Presbyterian Church is democratically representative in form and delegated in authority. The word presbyter is from the Greek, means elder, and occurs frequently in the New Testament. The members of a particular church elect ruling elders, and these are ordained, taking vows similar to the vows of the teaching elders or ministers. The government of a particular church is delegated by the congregation to its session consisting of minister and ruling elders. Particular churches are grouped into presbyteries; presbyteries are grouped

into synods; and the highest governing body is the General Assembly which customarily meets once a year.

Origin of Church. The origin and growth of the Presbyterian Church are fruits of the Reformation. Presbyterianism belongs to the Calvinistic branch of Protestantism, resulting from the doctrinal and ecclesiastical system developed at Geneva and solidified under John Knox in Scotland. The achievement of John Calvin in establishing a Presbyterian polity on a Biblical basis was realized only by a steadfast conflict maintained by him throughout his whole life. The practical and logical presentation developed by the Westminster Assembly in London in 1645-49 furnished the basis both for Presbyterian and many non-Presbyterian bodies. Under the charter of the Westminster Confession and the Westminster Catechisms thousands of followers of Christ returned to the Presbyterian principle which had been impressed upon the Apostolic churches, and this principle was developed through strong organization until to-day the Reformed Churches holding the Presbyterian system of government constitute the largest Protestant group in the world under a single governmental system. While the Westminster Assembly had no direct ecclesiastical authority, yet its deliverances on doctrine have had a marked influence on church life in many lands as well as in civil and national developments. In Scotland it resulted in the organization of several Presbyterian bodies which, after many years of separation, now constitute the great united Church of Scotland. Another of the Presbyterian strongholds was the north of Ireland, where many Scots for a time found a congenial home in transit to the United States.

In America. The beginnings of Presbyterianism in America date back to services held in isolated places from 1630 on through the 17th century. One of the earliest pioneers was Rev. Francis Makemie, who began his work in Maryland in 1683. The first presbytery organized in America is recorded to have met possibly near Freehold, N.J., in 1705. The first synod, composed of four presbyteries, was organized in Philadelphia in 1717 and was known as the Synod of Philadelphia. In 1788 the Synod divided itself into four synods and summoned the first General Assembly to meet. This body held its first session in Philadelphia May 24, 1789, and has held annual sessions ever since.

Several branches of the Presbyterian Church have developed in America, but the one still bearing the original title of the Presbyterian Church in the United States of America is the only branch that is national in its scope. It maintains particular churches in every state in the Union, organized into nearly 300 presbyteries and 46 synods. The General Assembly which met in Pittsburgh in 1931 was the 143rd annual General Assembly of this body.

From its beginnings in America the Presbyterian Church maintained high ideals of education, particularly for the ministry, and its present system of

colleges and theological seminaries throughout the United States dates from the Log College founded in 1726 at Neshaminy, Pa., by Rev. William Tennent, Sr., whose sons, John and William, Jr., became pastors of the historic Old Tennent Church at Freehold, N.J. The first Presbyterian theological seminary was established at Princeton in 1812 and has continued through the years. The Presbyterian Board of Education was established in 1819 and exists to-day under the title of Presbyterian Board of Christian Education. The Board of Publication which was established in 1838 is now a department of the Board of Christian Education.

Home and Foreign Missions. Presbyterian preachers in the early days of America were very largely home missionaries, and the Presbyterian Church in this country has always been a missionary church. The first Board of Missions was established in 1816. This name was changed to Domestic and then to Home Missions. The original work of this first Board continues to-day in the Presbyterian Board of National Missions. In 1837 the Presbyterian Board of Foreign Missions was established and still continues under its original name. The Presbyterian work of foreign missions, however, antedated this board as the Western Foreign Missionary Society, organized in Pittsburgh in 1831. The foreign missions of the Presbyterian Church in the U.S.A. to-day include Africa, China, Chosen (Korea), India, Japan, Latin America, Persia, the Philippines, Siam and Syria. The denomination has a share also in the United Mission in Mesopotamia and cooperates with other Protestant bodies in Christian work in Europe. Other branches of the Presbyterian Church maintain foreign missions in several countries. The national or home mission work of the Presbyterian Church extends from Point Barrow, Alaska, where the northernmost hospital in the world is situated, across the continent through Porto Rico.

The Presbyterian Church in the U.S.A. was the father of the pension system in this country. Its present strong Board of Pensions with millions of dollars of endowment is the outgrowth of more than two centuries of organized care for disabled ministers and widows.

Divisions of Church. The Presbyterian Church in the United States (South) is a division which has churches in the southern states and which has continued since the differences which arose in connection with the Civil War. The United Presbyterian Church of North America is a branch formed by the Union of the Associate and the Associate Reformed Churches, effected in Pittsburgh in 1858, and represents the earlier Covenanter and Secession movements of the denomination in Scotland. In 1931 steps toward organic union of the United Presbyterian Church of North America with the Presbyterian Church in the U.S.A. were in prospect of fulfillment. The Welsh Calvinist Methodist Church was united in 1920 with the Presbyterian Church in the U.S.A.

For many years the Presbyterian Church in the

U.S.A. has maintained a Committee or Department of Church Cooperation and Union which has steadfastly sought to effect the organic union of all Reformed Churches holding the Presbyterian form of government, and this department is frequently in conference with representatives of various other denominations. Through the years a spirit of comity has been fostered with all evangelical churches. The Presbyterian Church in the U.S.A. was one of the founders of the Federal Council of Churches of Christ in America and has for years held a large share in the Alliance of the Reformed Churches Throughout the World Holding the Presbyterian System. This alliance reports a grand total of over 50,000,000 members and adherents, of whom 9,878,000 are in the United States, 1,814,000 in Canada, 4,812,552 in Scotland, 1,077,000 in England and Wales, 462,413 in Ireland, 27,716,000 in continental Europe, and 4,623,000 in other continents.

In the United States Presbyterians count in their census only actual communicant members in good standing. Of these communicant members the largest bodies reported in 1931 the following: Presbyterian Church in the U.S.A., over 2,000,000; Presbyterian Church in the U.S. (South), about 460,000; United Presbyterian Church of North America, about 180,000. In contributions these three bodies reported for the year 1930: Presbyterian Church in the U.S.A., \$63,048,063; Presbyterian Church in the U.S. (South), \$14,307,835; United Presbyterian Church of North America, \$8,573,361. L. S. M.

PRE-SCHOOL CHILD. The child before it enters upon the formal schooling provided in the kindergarten or elementary school, that is, the child up to the age of four or five at the most, is the latest claimant for recognition and attention. Interest in the child before school age has developed from at least two angles, that of genetic psychology, which studies his mental and emotional development, and that of pediatrics, which has directed attention to the importance of a sound physical start in life. To some extent **PSYCHOANALYSIS**, with its emphasis on the importance of the early years for the emotional development of the individual, has also played a part. Accordingly the pre-school child has become the subject of study from the point of view of education, nutrition, psychology, and mental and physical hygiene. Institutionally the pre-school child has begun to be cared for in **CHILD GUIDANCE CLINICS** and in **NURSERY SCHOOLS**, both of very recent origin in this country and elsewhere. Less formally intelligent interest in the pre-school child is being fostered by numerous agencies for **PARENTAL EDUCATION**, and by attention given to the subject in home economics for girls in high schools.

BIBLIOGRAPHY—The Child Study Association of America has published bibliographies and monographs on this subject. See also National Society for the Study of Education, *Twenty-Eighth Yearbook*, 1929; A. Gesell, *Guidance and Mental Growth in Infant and Child*, 1930.

PRESCOTT, WILLIAM HICKLING (1796-1859), American historian, was born at Salem, Mass.,

on May 4, 1796. After graduating from Harvard at 18, he decided upon a literary career, choosing history as his special subject. A seriously impaired eyesight, the result of an injury sustained while at college, proved a considerable impediment in his work, but a powerful will, rigorous self-discipline and a remarkable memory more than counter-balanced this handicap. Prescott's first great work, the *History of the Reign of Ferdinand and Isabella*, was enthusiastically received in America and Europe upon its publication in 1837. The subsequent *History of the Conquest of Mexico*, 1843, and the *Conquest of Peru*, 1847, firmly established his reputation as one of the foremost historians of his time. The *History of the Reign of Philip II* was left uncompleted at the time of his death on Jan. 28, 1859. Prescott belonged to the "literary" school of historians, using the narrative style popular among his contemporaries. For him, the dramatic aspects of history had the greater appeal; he was content to set down events without seeking for causes.

PRESCOTT, a city in west central Arizona, the county seat of Yavapai Co., situated between the two sections of the Prescott National Forest, 80 mi. northwest of Phoenix. It is served by the Santa Fé Railroad and has an airport. There are gold, silver, copper, lead and zinc mines in the vicinity. Prescott was settled in 1863. Pop. 1920, 5,010; 1930, 5,517.

PRESENTIMENT, a strong subjective feeling of an approaching event, vague or definite, favorable or unfavorable. See **PREMONITION**.

PRESERVES, also called jams, jellies and conserves, a term applied to fruit preserved by sugar. Preserves usually consist of whole berries or small fruit, or uniform pieces of large fruit in a thick, transparent syrup. The fruit retains its shape and becomes tender, clear, and plump.

Jams consist of crushed, ground, or sliced fruit cooked with sugar. When finished, the pieces of fruit are in a jelly-like syrup.

Jellies are strained fruit juice cooked with sugar. The result should be a clear, tender, sparkling, quivering mold.

Conserves are similar to jams but are mixtures of fruit, with or without the addition of nuts or raisins or both. See also **CONSERVES**. M. S.

PRE-SHAKESPEAREAN AND SHAKESPEAREAN DRAMA. English drama, in the modern acceptance of the latter word, begins with the reign of Queen Elizabeth. According to the modern definition a drama must have a certain dimension, whether designated by acts and scenes or not. This distinguishes it from the **INTERLUDE**. Again, a drama must have a certain coherence of structure; and further, must exist for the purpose of an art, not as a moral example or for religious teaching. These latter characteristics distinguish what has been called "regular" drama from the **MORALITIES** and the miracle play (see **MYSTERY PLAYS**) that flourished in the Middle Ages. Two "regular" comedies were in existence when Elizabeth came to her throne: *Ralph Roister Doister*, an adaptation from the Latin of Plautus, and

Gammer Gurton's Needle, a farcical drama of contemporary village life; but it was not until 1561 that *Gorboduc*, the earliest English tragedy, was staged. This play, following a fashion already prevalent elsewhere in Europe, took the late Latin writer SENECA for an immediate model. All three of these plays were written for amateur performance by schoolboys and students at the universities or in the law schools of the inns of court. This kind of drama continued productive throughout the lifetime of SHAKESPEARE.

The early imitations of Latin drama (see ROMAN DRAMA), and other amateur efforts, were often used for purposes of royal and other entertainment. From them arose semi-professional troupes of players, managed by their singing-masters; the latter thus became not only the earliest theatrical managers, but often playwrights as well. Notable in their time were the boys of Paul's Cathedral and the Chapel Children who acted at a theater converted from certain rooms once belonging to the monastery at Blackfriars. The height of this phase of pre-Shakespearean drama was reached in the plays of JOHN LYLY who, as author and manager, staged a number of successful court dramas before Elizabeth between 1580 and the early years of the following decade. As a courtier Lyly exploited political allegory and administered polite flattery to his royal mistress in such plays as *Endimion* and *Campaspe*. Lyly was the first of his predecessors from whom Shakespeare learned the beginnings of his art.

It was not in the court drama, however, that the glories of Shakespeare originated. Popular entertainers known as minstrels had existed in England from early medieval times, and not infrequently troupes of them acted in Interludes and later in actual dramas. Out of these troupes several companies of actors gradually developed who, putting themselves under the protection of a nobleman to escape classification as rogues and masterless men, acted in inn-yards if not actually at times in the streets. The inn-yard was the original playhouse and several of its features, such as a platform extending far into the yard, galleries, few exits and fewer scenes, were carried over into the first structures built for theatrical performances. These were THE THEATRE, 1575; THE CURTAIN, 1576, and the celebrated GLOBE, in 1598. At first the actors in these rude companies wrote their own plays; later, several young men of university training, and others, were attracted by the opportunities the new drama afforded, and became playwrights. Several of these are habitually referred to as "the predecessors of Shakespeare." GEORGE PEELE, who transferred his talents from the court to the popular London stage, tried his hand at several kinds of plays, among them a CHRONICLE PLAY, *Edward I*, on English history; and a clever extravaganza, *The Old Wives Tale*. Lyly has been mentioned. THOMAS LODGE was a writer of charming poetry and short stories, among the latter the original of Shakespeare's *As You Like It*. Lodge's plays were few and unimportant. ROBERT GREENE, however, another of the group, has an important place in the history of drama. Like Lodge, Greene

wrote many short "pamphlets," a sort of early journalism, and, like Peele, he led a dissolute life and died early. But several of his plays—*Fiier Bacon*, which deals with necromancy in which is set a pretty comedy of love and the romantic, if unauthentic, *History of James IV of Scotland*—remain memorable among the plays which inspired Shakespeare. Equally conspicuous in this famous group was THOMAS KYD who, adapting Seneca to the popular stage, achieved a lasting success in *The Spanish Tragedy*. The attachment of Kyd's name to a play, now lost, on the subject of Hamlet long before Shakespeare touched that great theme, is another matter of much interest.

The greatest of Shakespeare's predecessors was CHRISTOPHER MARLOWE, who by sheer power and poetry raised tragedy to a new place in the drama. Marlowe gave the conception of the superman to the Elizabethan stage in such personages as Tamburlane, the overweening conqueror, Faustus who, lusting to know all, lost his soul; and Barabas, monster of inordinate revenge. The playwright's *Edward II* is the first great tragedy on an English king. Marlowe more than any of Shakespeare's predecessors exerted a direct influence on the master dramatist. His *Edward* courts comparison with Shakespeare's *Richard II*, and his *Barabas*, the Jew of Malta, with *Shylock*. He met a violent death after an ungoverned life. Kyd also died early, involved perhaps with Marlowe in obscure political intrigues. By the middle of the century's last decade the field was clear for Shakespeare.

It is by no means clear just how Shakespeare came to write for the stage. He was a recognized playwright in 1592, when Greene attacked him in plain allusion in his *Groatsworth of Wit*; and two years later his was a confirmed position in the Chamberlain's company of players, the most important of the age. This position Shakespeare maintained and strengthened in the King's Company, the title which these players assumed in 1603 upon being taken under royal patronage. Shakespeare was not an uneducated man, much less an illiterate. His knowledge of Latin, as of much else besides, was competent for the uses to which he put it; and his mode of life, except that there is nothing to show that it was ill-governed, and his habits in authorship appear to have differed not at all from those of his contemporaries. His personal life is peculiarly uneventful and quite unimportant, as he was little concerned with anything beyond telling his story well for the stage and making an honest living out of his art. He must have written plays for some 20 or more years and they group backward and forward about evenly, with 1600 as the central point and *Hamlet* as the probable pivot. Shakespeare began by writing plays with others or by revising them: the *Henry VI* histories are examples. Towards the end of his career he probably accepted some younger man like JOHN FLETCHER as a collaborator; *Henry VIII* is doubtless the result of such an association. Between these extremes he wrote, mostly unaided, one may feel sure, thirty-odd other plays, comedies realistic (*The Merry Wives of Windsor*),

romantic (*Much Ado About Nothing*), and pastoral (*As You Like It*). These involved many scenes of manners, as in *Twelfth Night*; farce, as in *The Comedy of Errors*, and burlesque as in the scenes with Bottom in *A Midsummer Night's Dream*. Shakespeare even wrote a PROBLEM PLAY, as one would call it to-day, *Measure for Measure*. All the passions are powerfully exemplified in the tragedies: love of various kinds and degrees in *Romeo and Juliet*, *Troilus and Cressida* and *Antony and Cleopatra*; jealousy in *Othello*, unscrupulous ambition in *Macbeth*; arrogance in *Coriolanus*, and misanthropy in *Timon of Athens*. Human nature strained by ingratitude beyond endurance is masterfully portrayed in *Lear*, and in *Hamlet* it is seen breaking under impact of a task supernaturally imposed. The series of plays dealing with the English kings from John to Henry VIII shows the fidelity of observation and transcription which makes Shakespeare the greatest of the realists. They are illumined equally with a beauty of thought, an elevation of the understanding, and an insight into the inner significances of things that make him the greatest of the poets. Shakespeare, in spite of the restricted conditions of his stage and his time, reached a higher degree of success and a greater uniformity of high achievement than any of his predecessors or successors. He dominated his age; but dramatically the age would have been great even without him. In the midst of Shakespeare's career of unparalleled and uninterrupted success, THOMAS DEKKER appeared with almost as amazing a combination of reality and poetry; and Thomas Heywood, called by Charles Lamb "the prose Shakespeare." Thomas Middleton, who must also be mentioned, knew London slums as few have known them. Webster was a master of horror in tragedy. BEN JONSON, followed by Marston, illuminated life with the glare of satire; and Fletcher, learning most of his art from Shakespeare, added a new levity to his comedy, and wrote tragi-comedies instead of the pure Elizabethan tragedies. These developments, however, came after Shakespeare. See also MEDIEVAL DRAMA. F. E. S.

BIBLIOGRAPHY—A. W. Ward, *History of Dramatic Literature*, 3 vols., 1899; F. E. Schelling, *Elizabethan Drama*, 2 vols., 1908; C. F. T. Brooke, *Tudor Drama*, 1911; A. W. Neilson, *Chief Elizabethan Dramatists*, 1911; J. Q. Adams, *Chief Pre-Shakespearean Dramas*, 1914; F. E. Schelling, *Elizabethan Playwrights*, 1925, and *Typical Elizabethan Plays*, new ed., 1931.

PRESIDENT OF THE UNITED STATES, the chief executive of the nation. Unlike the titular executives of certain other countries who bear the same title, the President of the United States is the chief executive both in name and in reality. His functions may be said to be twofold: political and administrative. In his political capacity he has become, in a sense at least, the prime minister of the nation. This is due in part to the fact that he is the one officer of importance in the United States elected nationally, and in part to certain powers conferred upon him by the Constitution which enable him to exert a tremendous influence upon public policy. Chief among these are the power of execu-

tive message and the VETO, although the right to summon special sessions of Congress should doubtless be mentioned.

"The executive power shall be vested in the President of the United States of America." Little qualifications indeed need be made by way of explanation of this sweeping grant of authority conferred upon the President in the opening sentence of Article II of the Constitution. The President of the United States dominates the Federal administration. In matters of appointments the President's power is somewhat checked by the constitutional requirement that all appointments to superior office receive the confirmation of the SENATE. As Commander-in-Chief of the Army and Navy the President exercises the powers customarily attached to that office by military law. The President, Vice-President and all civil officers of the United States may "be removed from office on impeachment for and conviction of, treason, bribery, or other high crimes and misdemeanors." Andrew Johnson, the only president ever subjected to impeachment proceedings, was acquitted.

For the constitutional provisions regarding the president of the United States, see CONSTITUTION OF THE UNITED STATES. S. C. W.

BIBLIOGRAPHY—S. C. Wallace, *Our Governmental Machine*, 1925; C. Beard, *American Government and Politics*, 1928.

PRESQUE ISLE PARK, the local name for Pennsylvania State Park, located across the bay from the city of Erie in northeastern Pennsylvania. The 7,700 acres of the park, of which 4,500 are under water, were turned over to the state of Pennsylvania in 1921 by the War Department. The ships with which Commodore O. H. Perry defeated the British in the BATTLE OF LAKE ERIE, Sept. 10, 1813, were built at Presque Isle.

PRESSBURG. See BRATISLAVA.

PRESSES, HYDRAULIC. See HYDRAULIC PRESS.

PRESSES, PRINTING. See PRINTING PRESSES.

PRESSES AND PRESSWORK. Presses were originally used for punching holes in metal instead of drilling them, and for shaping contours. Experience in designing presses and the dies used with them, together with the better materials now available, has made it possible to cut, bend, shape and draw metal at remarkably low costs. Press work covers the range from a "second" hand of the smallest watch to huge sheets for automobile bodies and also includes heavy metal sheets of intricate forms. The work is done with the metal hot or cold, according to the size and the nature of the material and the part to be drawn or punched. Presses vary from the simple, single acting ram or plunger to double or triple stroke presses that perform miracles with sheet metal. While most presses are operated mechanically by a crank or cranks, there are many hydraulic machines used mostly for heavy work. See also HYDRAULIC PRESSES. F. H. C.

PRESSURE, the force per unit area on a body or a surface, measured in DYNES, grams per square centi-

meter or pounds per square inch. Atmospheric pressure, for example, is approximately 15 lbs. per sq. in. In the case of gases in closed vessels, the pressure is equal in all directions and is independent of the shape of the vessel.

The hydraulic transmission of pressure (*see* HYDRAULICS) depends on PASCAL'S THEOREM that fluid pressure is transmitted equally in all directions throughout a fluid mass at rest; or, if the pressure at any part is increased, it is increased by an equal amount everywhere throughout the fluid mass. The hydraulic press, the hydraulic elevator and the hydraulic jack act on this principle. *See also* HYDRAULIC POWER TRANSMISSION. E. J. M.

PRESSURE, ATMOSPHERIC, the pressure exerted by the air around us and equal in any locality to the weight of the column of air extending above it. At sea level it amounts to about 14 pounds per square inch, or a little over a ton per square foot. The existence of this pressure was first demonstrated in 1643, by Torricelli, who invented the BAROMETER; its amount is often expressed by comparing it to the height of a column of mercury which would exert the same pressure. At sea level, the average barometric pressure equals that of 29.96 inches of mercury, this is often called one *atmosphere*. The atmospheric pressure decreases rapidly with altitude, about one inch per 1,000 ft.; at a height of one mile it is only 25 inches; at the top of Mt. Everest, 29,000 feet high, no more than 10 inches. The actual pressure in any locality, and more especially at sea level may vary by several inches owing to winds, and local temperature conditions, including diurnal and seasonal changes; it is these variations that produce the WEATHER. The values of 27 and 31 inches, respectively, represent about the minimum and maximum ever recorded at sea level. *See also* ATMOSPHERE.

PRESSURE GAUGES, instruments to indicate the steam pressure within a boiler. There are two classes, the Bourdon and diaphragm. The former comprises a bent tube, oval in cross-section, which fits into a circular case with a dial and pointer. The application of pressure tends to make the cross-section circular which causes the tube to unroll or straighten. This motion is transmitted to the pointer which indicates the pressure in pounds per square inch. In the diaphragm gauge the pressure flexes a corrugated disc or diaphragm, the motion of which is transmitted to a pointer as in the Bourdon Gauge.

PRESSURE REACTIONS, in industrial chemistry, gas reactions in which formation of the product is accompanied by a decrease in volume. Le Chatelier's principle states that if pressure be applied to a system in equilibrium, a change will take place to reduce the pressure, i.e., a reduction in volume occurs. Since liquids and solids do not in general react with significant decreases in volume, the effective utilization of pressure has to date involved gas reactions primarily.

Recent advances in the industrial application of high pressures have come about primarily because of the development of a new technique and new engi-

neering methods rather than to a sudden realization of the possibilities of pressure. Intensive research resulting in the development of new alloys of great strength and corrosion resistance have made possible the industrial realization of what were formerly merely ideas growing out of laboratory speculation. Concurrently with the development of the engineering phases, the field of catalysis likewise contributed largely to the successful industrial application of pressure. In order to cause gases to react or combine, it is necessary frequently not only to compress and heat them, but also to accelerate the rate of combination by means of a contact substance (Catalyst). The selection of catalysts is usually an empirical matter and, while knowledge is rapidly accumulating and some satisfactory theories of limited application have been developed, nevertheless much research is still necessary in this phase of pressure work.

The synthesis of AMMONIA from hydrogen and nitrogen by Haber was the first important pressure process to be developed. Modifications of this process, employing the same chemical reaction ($N_2 + 3H_2 = 2NH_3$) but differing mainly in the pressure used and in operating details, have been developed to such an extent that the world is now independent of all other sources of fixed nitrogen. Hydrogen is usually obtained from WATER GAS made from coke and steam, and nitrogen is taken from air, either by liquefaction and fractional distillation, or by burning out the oxygen with hydrogen. Most processes to-day mix these reactants, suitably purify them after compression and carry out the reaction over a heated catalyst. The ammonia formed is removed by condensation under pressure and the unreacted gases are recirculated together with "makeup" gas over the catalyst. In some cases no recirculation is used, but the gas passes through a series of catalyst chambers with ammonia removal between chambers until practically complete combination has occurred.

A process second in industrial importance only to the synthesis of ammonia is the synthesis of METHANOL (wood alcohol) from carbon monoxide or dioxide and hydrogen. The engineering features and equipment are very similar to those for ammonia synthesis.

The Bergius process for the hydrogenation of coal to form oils from which motor fuels and other valuable products can be separated is an important development. Recently a modification of this process, applying to petroleum oils, has been developed in the United States. These developments forecast many others in which valuable chemicals will be made from coke, steam and natural gas as raw materials.

N. W. K.

PRESSURE REGULATOR, a valve which reduces the pressure of steam, water, air or gas as it passes from one container to another. The pressure regulator permits the outlet of a high-pressure supply to a low-pressure pipe line or receiver, and maintains a constant predetermined pressure on the low-pressure side. It consists essentially of a valve opened by a

spring or weight and closed by the movement of a diaphragm actuated by pressure on the low-pressure side. Any reduction of the low-pressure below that value for which the valve is adjusted, will permit the valve to open and admit a sufficient flow from the high-pressure side to raise the pressure to the joint where it closes the valve.

PRESTER JOHN (also Priest John; John the Presbyter), a legendary priest-king who was supposed in the Middle Ages to rule over a vast realm either in the heart of Asia or in Abyssinia. He was first mentioned in the *Chronicle* of Otto of Freisingen (12th century), the legend of his fabulous wealth and power developing from that time on. Prester John appears in numerous medieval tapestries and paintings, in Ariosto's *Orlando Furioso*, and is mentioned in Shakespeare's *Much Ado About Nothing*.

PRESTON, municipal borough and port of Lancashire, England, situated upon a flat ridge above the Ribble, 209 mi. northwest of London. From Roman times the town's accessible position made it a trade center, but also exposed it to Scottish border raids. It was the birthplace of Francis Thompson, the poet, Lady Hamilton and Sir Richard Arkwright. A century ago, the prohibition movement began here. A fashionable center in the 18th century, modern industry changed conditions, and to-day it is primarily industrial. Although the ancient section retains many fine old dwellings, Preston is largely of modern construction in its churches, five parks, numerous public buildings and schools. The port, made independent in 1843, is under constant improvement as are the docks and quays. Cotton weaving is of first importance, and there are foundries, boiler and engineering works, shipbuilding and repairing yards and chemical and soap manufactures. Pop. 1921, 117,406; 1931, 118,839.

PRESTON, an industrial town of Waterloo Co., Ontario, Canada, situated on the Grand River, 55 mi. southwest of Toronto. Although in an agricultural area noted for live stock and dairying, Preston is largely given over to industrial interests including woolen mills and furniture, metal shingle, shoe and machine factories. Mineral springs make the town a health resort, and there are three modern resort hotels together with parks aggregating 90 acres, churches, and schools. Preston was incorporated in 1898. Pop. 1921, 5,423; 1931, 6,280.

PRETORIA, the capital of the TRANSVAAL and the seat of government of the Union of South Africa. It is 45 mi. of rail from Johannesburg. A modern city and the center of a fertile and irrigated region, Pretoria owes much to the important Premier Diamond Mine 25 mi. away. Railroad car shops and cement works are among the industries. Transvaal University and some beautiful government buildings are located here. The city was named after General Pretorius, first president of the South African Republic. It was captured by the British during the BOER WAR. Pop. 1921, 74,052; Europeans, 45,361; 1926, Europeans, 54,326.

PRETORIA CONVENTION. By a special proclamation of Sept. 29, 1879 Gen. Sir Garnet J. Wolseley declared the South African or Transvaal Republic, annexed by Sir Theophilus Shepstone in 1877, to be forever an integral part of Queen Victoria's domains in South Africa. The Boers, however, offered strenuous objections to this arrangement, and in Dec., 1880, war broke out. Armed hostilities lasted until the signing of a temporary peace on Mar. 21, 1881, after the Boer victory at Majuba Hill on Feb. 27. On Aug. 3, 1881 there followed the signing of a Convention at Pretoria whereby the Boer state was accorded complete self-government under the suzerainty of the English, and with certain reservations and limitations. In order to remove some of the more inconvenient restrictions and also to readjust the boundary line between British and Boer possessions, another Convention was signed at London on Feb. 27, 1884. The independent status of the republic was confirmed, but Great Britain reserved the right to veto within six months treaties made between the Transvaal Republic and any other power save the neighboring Boer region known as the Orange Free State. Moreover, there was to be no slavery in the new republic, religious liberty was established, foreigners were to be exempted from military service and were guaranteed the right to hold property, and England was to receive most-favored-nation treatment in commercial matters. The independence of the Transvaal was maintained until the conclusion of the Treaty of Pretoria on May 31, 1902, following the Boer War.

See E. Hertslet, *The Map of Africa by Treaty*, 3 vols., 1909.

PREVENTIVE MEDICINE. Preventive medicine includes all of the measures used by public health officers, by physicians, and by the public for the prevention of disease. For instance, vaccination against smallpox, or, again, the feeding of cod liver oil and calcium and the exposure to sunlight of infants in order to prevent rickets in preventive medicine, or the recommendation of a diet including all of the necessary vitamins, proteins, carbohydrates and mineral salts, and the drinking of sufficient amounts of water each day. There is hardly a phase of human life in which the knowledge of preventive medicine may not be applied.

The health department sees to it that the public has a good water supply. They prevent the sale of infected food; they arrange for proper disposal of sewage; they pour oil on the water in which mosquitoes breed; they check the pasteurization of milk; they advise mothers in the care of the child, and in many other ways also encourage the practice of preventive medicine.

Most of our present technique or preventive medicine has grown up in relationship to the knowledge that diseases are caused by germs. Hence preventive medicine assumes control of all epidemics in order to prevent those who are not infected from catching diseases from those who are. It sees to it that the person with a severe infectious or contagious disease is

isolated, either at home or in contagious disease hospitals. It keeps in QUARANTINE, or under restraint, the person who has been exposed to disease during the incubation period, a time when the person is especially infectious to others, before himself showing the disease. It keeps under control CARRIERS OF DISEASE who are themselves well but who carry the germs in their throats or intestinal tract and spread them to others.

Finally, preventive medicine sees to it that the linens a sick person has used, the utensils from which he ate, and his environment generally is freed from infectious material. For this purpose disinfection and fumigation were developed. Formerly such chemicals as carbolic acid and formaldehyde were used for this. More recently it has been found that thorough cleansing with soap and boiling water, thorough airing, and exposure to sunlight are sufficient for disinfection in most instances.

Preventive medicine is likewise concerned with prevention of disease in the individual by raising his individual immunity through the use of vaccination, the injection of vaccines and the injection of preventive serums. Thus a person who has suffered a wound in contact with the soil of a barnyard should have antitetanus antitoxin. Those likely to be exposed to infection in unsanitary drinking water should have antityphoid vaccination. Everyone should be vaccinated against smallpox. Children particularly should receive toxoid or toxin-antitoxin against diphtheria. There are also available vaccines and serums for various other diseases, which are discussed under their headings.

Another example of preventive medicine is the giving of small doses of iodine for the prevention of simple goiter.

The prevention of exhaustion and the control of fatigue must be included also under preventive medicine. Physical breakdown and, particularly, nerve exhaustion constitute one of our main sources of illness.

Cancer nowadays is prevented in many instances from spreading to the point of fatality by the use of early diagnosis and prompt surgical removal of the growth while it is still localized in some one small point in the human body.

The use of antiseptic substances to prevent infection of the skin following wounds, is a step in preventive medicine.

The venereal diseases are giving great concern to authorities in preventive medicine, because apparently there are only two methods by which they may be brought under control: (1) prompt treatment of all of those who are infected, so that they may not infect others; (2) education of those who are well concerning the danger of venereal diseases.

The prevention of food poisoning is largely a matter of proper inspection of food and solid and thorough cooking, since thorough cooking of foods will destroy the botulinus toxin and also the germs of botulism.

For hydrophobia there is the Pasteur treatment, which involves the prompt injection into the person

infected or bitten by a suspected dog of a vaccine made up of material from the dried spinal cords of infected rabbits. But preventive medicine is concerned also with the proper control of stray dogs and attempt has been made to prevent the spread of hydrophobia by vaccinating animals against the disease.

It is known that flies spread disease. Hence preventive medicine is concerned with the control of flies, insects and similar parasites.

Preventive medicine is also concerned with the question of narcotic addiction and the production of disease by the use of drugs of various types. Attempt to control such conditions are made through legal control of the sale of those drugs which may cause harm.

When seen early, the spread of most diseases can be prevented. Authorities in the field of preventive medicine urge periodic physical examination for detecting disease in its early stages, thereby making it possible to bring the disease under control.

Many diseases are associated with occupation. Hence employers are told about the possible dangers which may exist in the industry and means are provided for prevention of industrial disease. M F.

PREVEZA, a town on the seacoast of Epirus, Greece, located at the mouth of the Gulf of Arta. The chief exports are cheese, skins, wool and olive oil. Preveza was restored by the Turks after the first Balkan War in 1912 when it became the seat of a Greek nomarchy. Pop. 1928, 8,659.

PREVOST D'EXILLES, ANTOINE FRANÇOIS (1697-1763), French writer, known as the Abbé Prevost, was born at Hesdin, Apr. 1, 1697. He was educated by the Jesuits, and meditated entering their order. After some military service, he became a Benedictine. For 7 years he taught and preached, till, weary of cloistered life, he fled to Holland in 1727, and subsequently to England. During his exile he published his remarkable novels, *Un Homme de Qualite*, 1728, and *Cleveland*. *Manon Lescaut*, his masterpiece, a sequel to his first novel, is one of the outstanding novels of its time, a miracle of conciseness in a verbose age, and of marvelous characterization. In 1735 he returned to France by royal permission. Prevost died at Chantilly, Nov. 23, 1763.

PREVOST'S THEORY OF EXCHANGES. A body at a higher temperature than its surroundings gives up heat to them by radiation (*see* RADIATION OF HEAT); a body at a lower temperature gains heat from its surroundings. Prevost pointed out that it is illogical to assume that the actual absorption or emission of heat by a body is controlled by its surroundings, and he proposed the *theory of exchanges*, which states that each body radiates heat at a rate which depends upon its temperature, the nature and extent of its surface and other factors which pertain to the body itself, not to its surroundings. Also, the absorption of heat is determined solely by the condition, temperature and other factors of the body itself. The body and its surroundings are constantly radiating heat to,

and absorbing heat from, each other. If the body radiates more heat than it absorbs, it will give up heat to the surroundings and its temperature will fall, and vice versa. The temperature of a body remains constant when it is giving out heat at exactly the same rate that it absorbs it. W. W. S.

PREZZOLINI, GIUSEPPE (1882-), Italian critic and publicist, was born at Perugia, Jan. 27, 1882. With GIOVANNI PAPINI he founded and directed at Florence the noted critical journals *Il Leonardo*, 1903-07, *La Voce*, 1908-16, and with Papini he produced *Italian Culture*, 1925, and other works. Among his political writings are *Syndicalist Theory*, 1909, *The New Nationalism*, 1915, and *Fascism*, 1924. His great critical biographies include *Papini*, 1924; *Mussolini*, 1925, and *Machiavelli*, 1927. Prezzolini's "militant idealism" and cultural propaganda dominate the new Italy.

PRIAM, in Greek mythology, son of LAOMEDON and the last king of Troy, husband of HECUBA and father of HECTOR, PARIS, POLITES, CASSANDRA and many others. He was said to have 50 sons and 50 daughters, although only 19 by Hecuba. At the outbreak of the Trojan War Priam, being an old man, took no active part in the fighting, but aided the Trojans with his advice. Neoptolemus killed him at the altar of Zeus where he had taken refuge.

PRIBILOFF ISLANDS, also called Fur Seal Islands, a group of four islands forming part of Alaska, lying in the Bering Sea. The largest are St. Paul and St. George. These islands are owned by the United States and are administered by the Department of Commerce. They are important on account of the large herd of fur-seals which the United States government owns. In 1928 this herd numbered more than 800,000 seals and in the same year over 30,000 skins were obtained. There are only about 300 inhabitants.

PRICE, the exchange value of a commodity or service. While the exchange value of goods or services is sometimes measured in terms of other goods or services, the value of such goods is ordinarily expressed in terms of money. A price is said to be higher when more money is required to purchase a standard unit of goods than was required for the same purchase at a given previous time.

To a large extent prices of commodities are indicative of the SUPPLY AND DEMAND of such commodities. They are also indicative of the value of LABOR and CAPITAL since, in general, rising prices accompany a rise in the scale of wages and in the rate of interest whereas falling prices attend unemployment or lowered wages and a decreased return on invested capital.

Commodity prices are determined by various considerations, among which are conditions affecting the amount of money or credit available; cost of production or manufacture; rate of turnover; supply and demand; and change in the prices of other commodities. According to the QUANTITY THEORY OF MONEY an increase in money by lessening the value of money tends to raise prices. This was demonstrated in Ger-

many during the period of inflation following the World War when the mark depreciated in purchasing power. Other things being equal, prices rise with increased demand and fall with increased supply. However, at times a heightened demand for a commodity stimulates new methods of production which then lower prices. On the other hand, when the market is glutted prices are often artificially sustained. Prices of commodities interact upon each other where they are jointly consumed or are put to similar or different uses. For instance, a drop in the price of coffee tends to raise the price of sugar. Similarly, a lowered price for woolen goods has a tendency to reduce the price of cotton goods; while a rise in food prices generally lessens the price of luxuries.

These principles of price variation will at times nullify each other. No single principle controls all situations. C F. WE.

PRICES, STATISTICS OF. See INDEX NUMBERS.

PRICKLY ASH (*Xanthoxylum americanum*), an acrid aromatic shrub of the rue family with spiny stems and ashlike leaves, called also toothache tree. It grows in open woods and thickets from Quebec to South Dakota and southward to Virginia and Kansas. The shrubby stems, usually 6 to 12 ft. high, bear pinnate leaves, greenish flowers in axillary clusters and fleshy, two-valved pods containing black shining seeds. The similar but larger and more densely spiny southern prickly ash (*X. Clava-Herculis*), called also Hercules'-club, with green flowers in profuse terminal clusters, is found along streams in the southern states. The bark of both species contains a powerful resin used medicinally as a tonic and as a remedy for toothache.

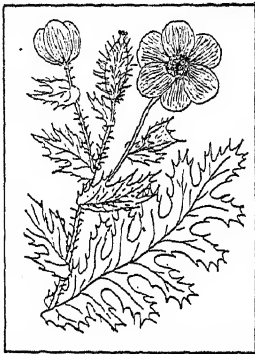
PRICKLY HEAT, or miliaria, a crop of small red papules with superficial lesions on the skin, caused by the clogging of inflamed sweat glands after an excessive period of sweating. It is accompanied by itching, tingling and burning. It may occur on any part of the skin, but is more common on the anterior of the trunk. Treatment is seldom needed, as relief is usually found by the application of mild astringents and powder. During the attack, it is advisable to refrain from excessive exercise and take as little fluid as possible.

PRICKLY LETTUCE (*Lactuca Scariola*), a biennial herb of the composite family by some authorities regarded as the parent species of the garden LETTUCE. It is a native of Europe and Asia, widely naturalized as a weed in North America and various other parts of the world. The very smooth stiff stem, 2 to 7 ft. high, bears numerous, prickly, often vertical leaves, which in open situations frequently stand with their edges pointing north and south. See also COMPASS PLANT.

PRICKLY PEAR, a name applied to a numerous genus (*Opuntia*) of cacti so called because of their spiny fruit. They are all natives of America but several are extensively naturalized in other regions, especially in Mediterranean countries, and also in Australia where they have become pestiferous. The fruit

of the Indian Fig (*O. Ficus-indica*) is edible; the tuna (*O. Tuna*) is grown as a hedge plant. *See also* CACTUS; OPUNTIA.

PRICKLY POPPY (*Argemone platyceras*), a stout spiny herbaceous plant of the poppy family, called also chicalote. It is native to the southwestern states from Texas to California and southward to South America, and more or less planted for ornament. The robust, usually annual stem, 1½ to 4 ft. high, with an acrid orange-colored juice, bears smooth, deeply cut, spiny-toothed leaves; showy, white flowers, 2 to 4 in. across, and densely prickly seed capsules. *See also* CALIFORNIA POPPY; CELANDINE; CREAM CUPS; POPPY.



P. A. RYDBERG, "FLORA OF PRAIRIES AND PLAINS"

PRICKLY POPPY

PRIDE AND PREJUDICE, the first novel written by JANE AUSTEN; published 1811. This well-bred domestic drama of 18th century England has as its central theme the love of high-spirited Elizabeth Bennet for Mr. Darcy, a young man whose wealth and pride of family create in the heroine's mind many unfavorable prejudices—all of which are overcome, finally, by love. As is true of all the Austen novels, the plot is never of such engrossing interest as are the characters, and this work is especially well supplied with people whose various foibles one delights in watching. These characters include Mr. Bennet, with his gentlemanly attitude of *laissez-faire*; ambitious Mrs. Bennet; the beautiful Jane, and her romance with Darcy's friend, Mr. Bingley; the impetuous young Lydia Bennet, and her elopement with the fascinating Wickham; and last, the strait-laced clergyman, Mr. Collins.

PRIDE OF CALIFORNIA (*Lathyrus splendens*), a slender slightly shrubby perennial of the pea family called also camp pea. It is native to the mountains of southern California and sparingly grown for its showy deep red flowers somewhat resembling those of the sweet pea.

PRIDE OF INDIA, a name applied to the CHINABERRY, a handsome tree of the mahogany family native to southern Asia and widely grown for ornament in warm regions.

PRIDE'S PURGE, the expulsion from the English Long Parliament in 1648 of all members opposed to the execution of Charles I. The execution having been decided upon by the army after the suppression of the King's supporters in Scotland, Col. Pride was ordered by the arrest of recalcitrant members to secure in Parliament a group that would make the proper legal arrangements. This was accomplished by the abolition of the House of Lords and an institution of a special court to try the King.

PRIE-DIEU (French, pray-God), a small, slanting desk, shaped somewhat like a music stand, with

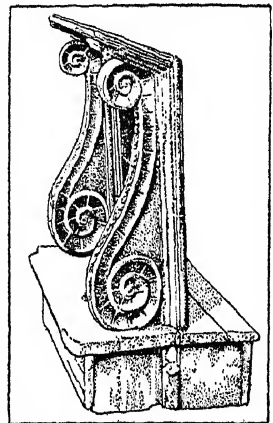
a raised step on which to kneel, and usually made of carved wood. It is used chiefly in oratories or other rooms in private homes for purposes of prayer, the desk part being reserved for devotional books. Some very old *prie-dieus* of age-blackened oak still survive.

PRIESTLEY, JOSEPH

(1733-1804), English discoverer of oxygen and natural philosopher, born at Fieldhead, near Leeds, England, Mar. 13, 1733. After education at Daventry, a pastoral charge in Suffolk for six years (1755-61) and a tutorship at Warrington Academy, he published, in 1767, his *History of Electricity*. That work, with his researches in "different kinds of air," opened up his life work. Following a European tour with Lord Shelbourne, he announced in Paris, in 1774, his discovery of "dephlogisticated air," later called oxygen. His home at Birmingham, England, was destroyed in 1791 by a mob, which burned his manuscripts and instruments, the penalty which he paid for his sympathy with the French Revolution. He came to America in 1794 and spent the last ten years of his life quietly at Northumberland, Pa., where he died, Feb. 6, 1804.

PRIESTS (Hebrew, *Kohanim*), the descendants of the first Biblical high priest, Aaron. The priests in ancient Israel supervised and carried out the sacrificial system and the religious rites, practices and usages observed in the Temple at Jerusalem. According to the Pentateuch (Numbers 3:5-10; 8:19), Aaron and his sons had been chosen in perpetuity by God for the hereditary office of the priesthood, a selection which in later days was confirmed unto Zadok and his descendants, under King Solomon, for all time.

According to the Pentateuch, Moses was the organizer and founder of the priesthood; it was he who, at the divine command, conferred upon Aaron the office of priest and established it as hereditary among the descendants of his family. Actually, however, this preferment of the house of Aaron did not occur until the latter part of the 7th century B.C. The chief function of the priest in ancient days seems not to have been the offering up of the sacrifices, but the giving of instruction in the Law, the imparting to the people of the divine will, the duty of deciding in matters of legal disputes, of being arbiters in all ethical and judicial questions, and especially that of consulting the sacred oracle. Subsequently the priests were lifted above their humble origins and granted the full privileges of the priesthood; they became a fixed order, with their abode at Jerusalem, and had the sole right of bringing offerings before God and of min-



FLORENTINE PRIE-DIEU
Found in Andrea del Sarto's paintings, it is often called after him (16th century)

istering at the sanctuary in Jerusalem. The Levites became their subordinates and servants. The high priest himself was unheard of in Israel until a much later period; even the prophet Ezekiel makes no mention of such a person.

The priesthood ceased to function in Israel after the destruction of the Second Temple in 70 A.D., and the consequent abolition of the sacrificial system. The rabbis slowly superseded them as teachers of the Law and the instructors of the people, until the priesthood became only a memory. However Judaism preserved certain of these old privileges intact, and still accords them to those who are acknowledged to be of priestly descent. Thus the first of the seven men who are called up for the reading of the Torah, or Scroll of the Law, in all Orthodox Jewish congregations to-day is always a priest, or Kohen, and only descendants of the priests have the right, assisted by the descendants of the Levites, to deliver the Priestly Blessing. (Numbers 6:24-26.) These two customs are no longer observed in Reform Jewish congregations. A. SH.

See Graetz, *History of the Jews*, 1926

PRIGG VS. PENNSYLVANIA (1842), a case involving the rights of states in surrendering fugitive slaves which led to a notable decision by the United States Supreme Court. Prigg was the agent of a citizen of Maryland, owner of a Negro woman who had escaped into Pennsylvania. Under warrant from a Pennsylvania magistrate, Prigg caused the slave and her children to be apprehended; but the local authority refused to take further cognizance of the case. Prigg thereupon forcibly removed the fugitives to Maryland, delivering them to their owner. Subsequently he was indicted by the State of Pennsylvania for felony. Prigg appealed from the adverse judgment of the Supreme Court of Pennsylvania on writ of error. Justice Story, delivering the opinion of the court, declared that the statute of Pennsylvania under which Prigg had been indicted was unconstitutional and void, but added that the Court regarded the Fugitive Slave Act of 1793 constitutional, "and, indeed, with the exception of that part which confers authority upon state magistrates, to be free from reasonable doubt and difficulty." The decision implied that state legislatures might constitutionally prohibit state magistrates from assisting in the rendition of fugitive slaves. Several northern states quickly took advantage of the implication. These acts, practically destroying the machinery of enforcement of the Act of 1793, led the southern states to demand a revised, stronger FUGITIVE SLAVE LAW, 1850.

PRIMARIES, preliminary elections by which candidates for public offices are chosen by ballot of the voters of a party. The method is particularly characteristic of American state electoral machinery (see ELECTORAL SYSTEMS), where its use and development grew out of distrust of the nominating methods of party conventions (see CONVENTIONS, POLITICAL.). Since 1903 it has been made mandatory in some form in all but five states of the United States.

PRIMATE Latin *primas*, the first or foremost. In the Catholic Church some ARCHBISHOPS (metropolitans), as in the Eastern Church the EXARCH, have the precedence and certain rights of jurisdiction over the other metropolitans of a country. The pope is the primate of the entire Roman Catholic Church. After the 4th century, the bishop of the capital of a province, the metropolitan or exarch, sometimes had the title of primate. Later it was the official title of bishops who functioned as papal vicars and LEGATES. It is now largely a title of honor.

PRIMATES, the highest order of mammals, comprising the lemurs, tarsiers, monkeys, apes and man. This series is arranged in order of increasing complexity and resemblance to man. The size of the organism also shows, on the average, a steady and rapid increase as we advance from the lemurs to man, if we include the relatively small gibbons, among the great apes. In general, there is a progressive decrease in the importance of the tail. In lemurs and in most monkeys it plays an important rôle, being used to help the animal balance and steer itself, and also as an auxiliary grasping organ. In the great apes the tail is entirely absent, and there are a few monkeys who represent an intermediate stage in which there is a very small or rudimentary tail. Of special interest is the progressive change in the configuration of the head. The primate head in general tends to evolve from the "rodent-like, elongated head with conspicuous muzzle" found in lemurs to "the approximately spherical and short-jawed condition in man." Also, "as the muzzle diminishes in length and the head gradually approaches spherical form, the facial angle rapidly increases" (Yerkes). As Yerkes points out in *The Great Apes*, we must be exceedingly wary in attempting to draw inferences from structure to biological function, but certainly the brains of monkeys do tend to be more complex and more like human brains than those of the lemuroids and less human than those of the man-like apes. Thus the brains of some lemuroids have relatively small cerebral hemispheres which do not entirely cover the cerebellum as they do in man. The cerebral cortex in these lemuroids is also almost smooth, instead of showing complex convolutions and being definitely lobated like those of the anthropoid apes and man. When we try to make more subtle comparisons, however, as between two types of anthropoid ape, the gorilla and the chimpanzee, the parallelism between structure and function is no longer clear, for although the gorilla brain is neurologically and physiologically more like the human, the chimpanzee, despite his smaller size and somewhat simpler brain, is in many ways superior to the gorilla in mental development, notably in adaptability and alertness.

The monkeys and anthropoid apes appear to be of relatively recent origin as compared with the lemuroids and tarsoids. Fossil remains of Old World monkeys have been found belonging as far back as the Lower Oligocene period, however. There is considerable evidence, also, that monkeys and apes were at one time

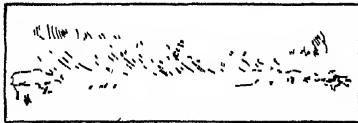
far more widespread than they are at present, extending into Europe, where they are no longer indigenous. It is probable that both the anthropoid apes and man descended from some common ancestral form which is no longer extant. See also ANTHROPOID APES; EVOLUTION; PREHISTORIC MAN.

BIBLIOGRAPHY.—D. G. Elliot, *Review of the Primates*, 1912, Wm Kohler, *The Mentality of Apes*, 1925, F. W. Jones, *Man's Place Among the Mammals*, 1929; R. M. and Ada Yerkes, *The Great Apes*, 1929

PRIME MOVER, any machine used to convert potential or kinetic energy occurring in natural forms into mechanical energy. The steam engine, steam turbine, internal-combustion engine, water turbine and windmill (see separate articles on these subjects) are the common prime movers. The steam engine, steam turbine and internal-combustion engine utilize the potential chemical energy of fuels, while the water turbine and windmill operate upon the kinetic energy of water and air, respectively. The electric motor is not a prime mover as it requires energy in a form the production of which involves one of the above-mentioned movers.

PRIME NUMBERS. An integer which is divisible without remainder by no integer except unity and itself is called a *prime number*. For example, the prime numbers below 100 are: 1, 2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47, 53, 59, 61, 67, 71, 73, 79, 83, 89, 97. EUCLID proved that the number of primes is infinite, and hence that there is no greatest prime number. A mathematical formula expressing all prime numbers has never been discovered. In 1640 Fermat announced the formula for primes $2^{2^n} + 1$. The numbers obtained from this expression are known as Fermat numbers. Euler showed that the fifth Fermat number is not prime, and this was later shown for the twelfth and twenty-third. See FERMAT'S THEOREM; WILSON'S THEOREM; FACTOR.

PRIMITIVE ART. The significance of prehistoric art and its bearing upon art history has undergone a fundamental change in the 20th century, due to the important discoveries made in all parts of the world by scientifically trained explorers and excava-



COURTESY AMER. MUS. OF NATL. HISTORY

PRIMITIVE DESIGN OF A REINDEER HERD

tors. A revaluation has been necessary to fit the details of this vast amount of material into a comprehensive plan. For convenience, the prehistoric period is a term made to include the time from man's first appearance on earth to the earliest written records, and is subdivided into the three ages of Stone, Copper and Bronze, and Iron.

The main facts which the archaeopological work of the past few decades has brought to the forefront and which have closest bearing upon a better understanding of primitive art, are: first, "that, even in the in-

conceivably remote past, man was a relatively superior being, walking erect, and with very capable tool-making hands guided and directed by a very superior order of brain, and also that he was a great traveler, hunter and explorer", second, the cyclic idea of evolution in the rise and fall of civilizations, each marked by a flowering followed by decay, death and a new rebirth.

Art, the universal language of man's inner life, reflects this intermittent phenomenon. Between the recorded history of great civilizations there have stretched dark ages of crass ignorance, during which all recollection of these traditions was lost. In the greater unrecorded cyclic waves geologic changes have wiped the slate clean of every trace of artistic effort. There followed long periods of nomadic existence and a fresh upward trend, culminating in achievement higher than ever before. Across the long stretches of time it is the uneven waves of progress and retrogression that cause much of the confusion in attempting to classify dogmatically these sporadic art impulses in chronological order. Certain art periods may well represent the degenerate remnant of an old and worn-out race, or the precursor of a race on the upward swing of the tide. There would be as much reason for maintaining that Bushman art, comparable with early Paleolithic art, if exhumed after the present generation had been wiped from the earth by glacial ages, represented the height of 20th century civilization. There were then as now races in different stages of evolution, inhabiting different parts of the earth and even the same parts of the earth at the same time. The best mural drawings, and they were excellent drawings, have been ascribed to early Paleolithic times, the earliest recognized period, those coming later being in no sense comparable.

The art treasures found in a mere scratching of the ground by a few workers in Egypt prove a well-developed art in remote antiquity, and arouse high hopes for what may be found in the desert places of central Asia, now believed by many authorities to be the first home of man. Among the Mongolians art and culture appear to have been full-grown from time immemorial. Discoveries made almost daily confirm the belief that the Americas attained a high degree of artistic development while the Europeans were wandering savages. Along the Delaware and the Missouri rivers, and in Yucatan and Buenos Aires are found pottery and incised figures on funeral vases, with the same type of broad shoulder and slender waist of the hunter as is found in Egypt, which is also linked to Scandinavia through the bronze workmanship. The textile designs of the earliest native of America suggest him to be of Mongol origin.

While the first evidence of artistic effort has been discovered in western Europe, it is believed the artistic faculty was brought over from Asia by new, incoming races. This faculty was gradually developed by them in spite of the pressure of the struggle for existence, caused by the advance of the third great glacial period. Nomadic life gave way to cave-

dwelling and dependence upon supernatural powers. The birth of art was a resort to magic rather than an indulgence of the esthetic impulse, designed to bring animals within the hunter's power, and increase their fertility as well as to provide himself with a magical power against animals whose dwellings he shared. Evidence of the magical character of primitive art is found in the arrow wounds inflicted upon the portrayed animals, a practice even to-day among primitive peoples. Also these magical images were found hidden in the most inaccessible recesses of caverns. Later the magical note became more dominant in the depiction of sorcerers and "medicine" men with all the characteristics of the "witch doctor." That this was a common practice is seen by the marked similarity of the numerous engraved images throughout the eastern Pyrenees to the famous *Sorcerer*, a painted figure in relief in *Les Trois Frères* discovered in 1914. Each figure is given a fox's tail and the heads are provided with stag horns and a long pointed beard. A mask is shown with fox's ears, and the body striped or covered with a pelt. The superposition of figures many times over without regard to arrangement suggests magical rather than artistic intent.

Sculpture and engraving are supposed to have preceded painting. The earliest records, believed to have been made about 50,000 years ago by the mixed Cro-Magnon race, have been found in the Pyrenees-Languedoc region and the valley of the Vézère in Dordogne in southern France. Two bison were found there modeled in clay, giving evidence of great skill in the handling of this medium and remarkable accuracy in anatomical details, particularly in the muscular development of the animals. The most celebrated discovery of prehistoric sculpture of the human figure is known as *La bonne femme de Laussel*, a lumpy, awkward figure in marked contrast to the lithe and broad-shouldered *Le chasseur* but a few feet away. Neither of these figures compares in skill with animal sculpture, and are doubtless of another period or tribe. The best-known prehistoric engraving is called *The Feeding Reindeer*, discovered in 1874 in the Thaygen Grotto, Switzerland. It is a remarkable piece of engraving covering both sides of a piece of antler, yet forming one continuous picture. This is the earliest instance known to-day of a landscape background; it shows a stream and herbage, with the reindeer tranquilly browsing. *The Dying Reindeer*, incised on stone and discovered at Gourdan, is another example of the artist's ability to present the essentials of expression in the fewest possible lines. The Reindeer period, also known as the Paleolithic art age, marked the height of prehistoric art. Later periods never succeeded in reaching this crest. The culmination of the artistic efforts of the cave artist were along the lines of polychrome mural painting during what is called the Magdalenian Epoch. Reindeer and bison were the favorite subjects, rendered in incised outlines which were filled in with black or white pigment. The surface within the contours was scraped clean, then covered with layers of red,

brown and yellow colors. Skillful naturalistic shadings were obtained from these colors through scraping and rubbing. Lastly hoofs, horns and minor details were added in black. The pigments were earth colors, ground fine and mixed with animal fat, with binding mediums of balsams, plant saps, milk and blood serums. Brushes were made of finely frayed bone ends. While there was a sense of perspective,



COURTESY AMER. MUS. OF NATL. HISTORY

REINDEER ENGRAVED IN ROCK
From the Museum of St. Germain

there was no attempt at composition or correlation of figures in groups. Throughout there was a suggested symbolism. Fish represented about the legs of animals conveyed the idea that the animals were crossing a stream. Through all these images runs an unexplained ideographic record; an art speech which may have been a primitive writing or shorthand, or picture maps of the immediate localities, pictures executed or in commemoration of tribal wanderings.

The Neolithic (or polished stone) age marks the downward trend from the high spirit of adventure of the Paleolithic hunters to barbarism and a reversion to cannibalism. With the pursuit of agriculture and the domestication of animals the utilitarian spirit prevailed and the only survival of the former art expression was confined to the ornamentation of useful objects, such as the carving of a dagger hilt or a spear-thrower. The making of pottery was the distinguishing artistic feature of this period. Gradually the crude form and texture of these clay vessels improved and design was added, incised or by pressing a cord in different directions on the clay before it was baked.

After the discovery of the use of metals, the evolution of art cannot be confined to periods; civilizations were at too extreme variance. Copper was first used in a pure state, but how or when it began to be mixed with tin to form the alloy bronze remains unknown. Molds for its casting, of indeterminate age, have been found and its use was widespread. Elaborate bronze trumpets six feet in length were found in Denmark, and to-day are used at concerts at the Museum of Copenhagen. They still give forth clear ringing notes, though they are estimated to be several thousand years old. Throughout Scandinavia copper and bronze was worked with great ornamental skill. The high artistic skill seen in the metal work of Egypt is described in the article on EGYPTIAN ART. Amber and jet were highly prized at an early period.

Virgin gold was worked as early as the Paleolithic age. The use of iron brings one within 1,000 years of the Christian era. While its early use is not clearly defined, iron-working comes within the period of recorded history. The superiority of iron over bronze as a cutting tool led to rapid and great changes in the life of man. Weapons of iron gave him a greater advantage in conquering his enemies. Little doubt exists that there was constant intercommunication and commercial relations between peoples not only close at hand but at great distances. The use of metal and semi-precious stones gives evidence; these materials, existing only in remote regions, were in general use in the more progressive countries.

Artistic effort and temples of worship went hand in hand as civilization advanced. The first stone architecture was of religious intent, and was possible only through man's primary artistic efforts and his understanding of the laws of symmetry. All his artistic accomplishment was deposited within his temples; a part of the rite of the reverent burial of the dead was the placing about the body of valuable and personal works of adornment. Precious stones embedded in skillfully wrought vessels of gold and bronze for religious ritual, and images and decorations in honor of deities have always united art and religion, and preserved the history of art.

BIBLIOGRAPHY—E. A. Parkyn, *Introduction to Study of Prehistoric Art*, 1915, G. B. Brown, *Art of the Cavedwellers*, 1928, H. G. Spearing, *Childhood of Art*, 1930.

PRIMITIVE DRAMA. It is not difficult to discover why even the most primitive peoples indulge in theatrical expression. Lacking a scientific explanation of natural phenomena, they formulate magical theories, and these theories invariably lead to imitation, for according to the principle of sympathetic magic, if one imitates a thing one acquires or invokes the essential qualities of that thing. Thus, if one wears a lion skin and does a lion dance, one acquires the strength and courage of the lion. If one wears a mask representing a god, one partakes of godliness. Further, if one executes a ferocious war dance and hurls imprecations at an enemy, the enemy feels the effects of the dance and imprecations, and is partially defeated before the actual battle.

Primitive society invents drama chiefly for practical purposes: to aid the hunter before the hunt, the warrior before the battle; to bring rain; to cause crops to flourish; to insure the fertility of women; to appease whatever deities require appeasing and to impress neophytes with the sacredness of tribal laws. It is seldom, though instances do occur, that strictly primitive people employ drama simply as a means of entertainment. Consequently their plays are more frequently serious than comic.

The first expression of the drama is the **DANCE**, for bodily expression is more natural than speech. From the beat of a drum rises the first crude play. First comes rhythm, as an expression of elemental emotions such as love, hate and fear; then bodily imitation, with magical intent, superimposed upon the rhythmic

pattern; then sounds, developing into words expressive of the emotions. The words added to the musical pattern of the dance make a poem, a chant, a song. There follow love songs, war songs, hunting songs, harvest songs. Improvisations become traditional ceremonies, and the drama is crystallized into an art form which, long after its superstitious basis has disappeared, holds its place in the affections of the people. Utilitarian values give way to the esthetic as civilization evolves, so that even an advanced society clings to vestiges of its early drama.

In Greece, Japan, Polynesia, Alaska or Mexico, the story is much the same. Though gods, masks and words differ in detail, the themes are alike for like stages of culture. And modern society turns time and again from its intellectual music and its prose drama to quicken its spirit at the shrine of primitive art. In the dance-dramas of the red Indians, the barbaric rhythms of the Negroes, the puppet-figures of the Javanese (*see JAVANESE DRAMA*), it finds emotional satisfaction such as only the primitive drama affords.

G. HU.

BIBLIOGRAPHY—F. B. Gummere, *The Beginnings of Poetry*, 1901, 1908; Ridgeway, *Dramas and Dramatic Dances of the Non-European Races*, 1915; Havemeyer, *The Drama of Savage Peoples*, 1916, Frazer, *The Golden Bough* (abridged), 1922; Macgowan and Rosse, *Masks and Demons*, 1923.

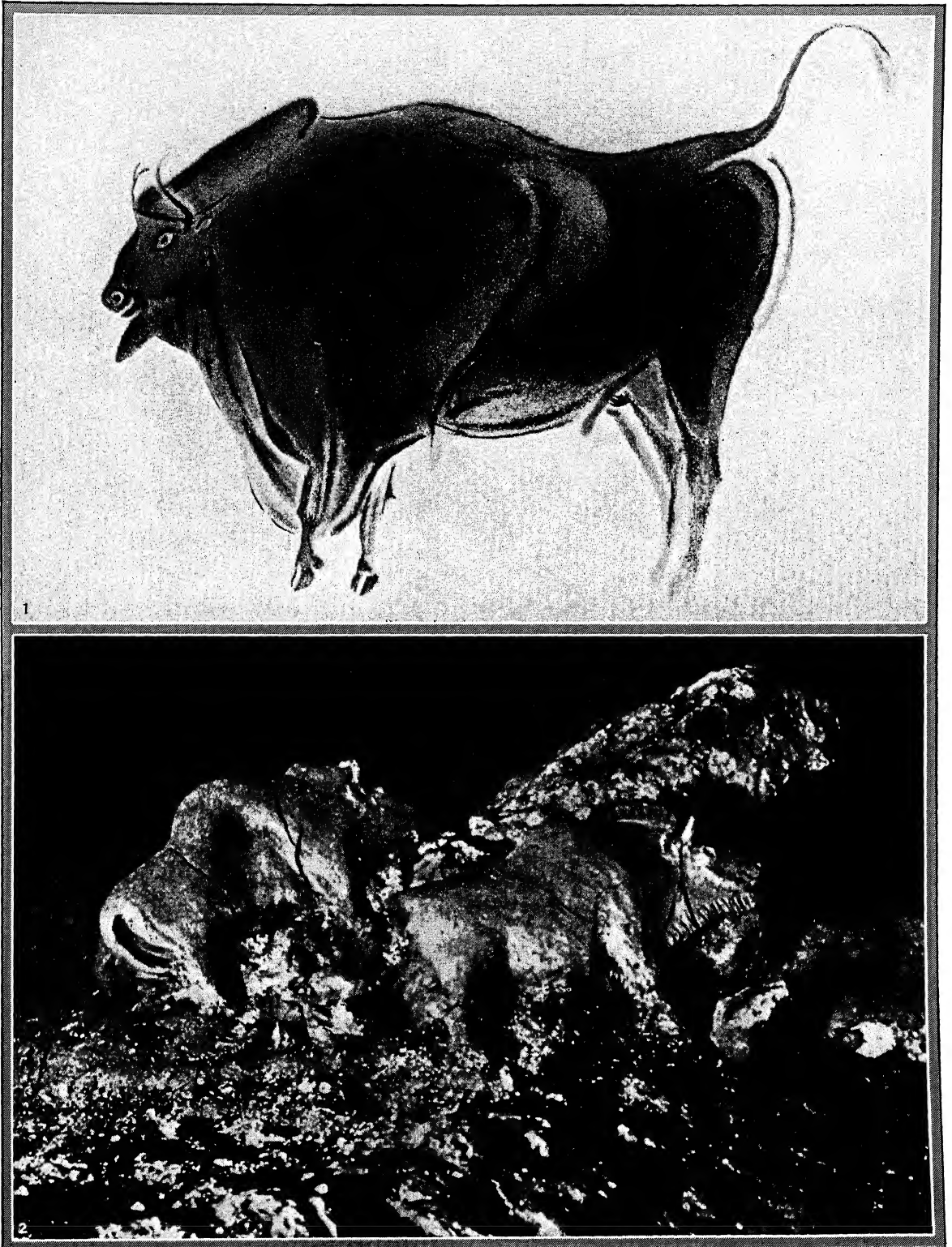
PRIMITIVE ECONOMICS, the getting and spending of wealth by primitive people. In the simplest communities, where **WEALTH** consists only of food, clothing and weapons, each family makes or acquires these for itself, the only division of labor being that between men and women.

It is understood that members of a family owe certain services to one another. Among the Plains Indians, the son-in-law should hunt for his father-in-law. In the Trobriand Islands, the brother should raise vegetables for his married sister. But these services are presented as a gift. They cannot be demanded and paid for and, if they fail, the only penalty is the scorn of the community.

The system of giving instead of bartering holds when exchange is made between people not members of the same family. The shore dwellers and inland dwellers in the Trobriands exchange vegetables and fish without even seeing each other. The inland people bring baskets of vegetables to the shore, each to the house of a designated person, called his trading partner. They leave the baskets and retire. Then the fishermen come out and substitute for the vegetables what they consider a generous quantity of fish. Should any one feel dissatisfied with his bargain, his only remedy is to spread the news that his trading partner is stingy or to make magic which will induce him to be more generous next time.

Trading by the system of gift exchange is carried on all over the world, and sometimes with a high degree of ceremony. The Trobriand natives trade arm bands and necklaces as gifts and with magic ceremonies to increase generosity. The Indians of the northwest coast of America make it their ambition in life to accumulate property which shall be given

PRIMITIVE ART



COURTESY AMERICAN MUSEUM OF NATURAL HISTORY

PALAEOLITHIC ART

1. Polychrome painting of a bison found on the walls of a cave at Altamira, near Santander, Spain.
2. Two bison modelled in clay, found in the cavern of Tuc d'Audoubert, France. Magdalenian Epoch.

away at a huge feast called a potlatch. Every one invited to this feast is expected to accept the blankets and food given him and to return them, within a year, at another feast, with a 100% interest. At a potlatch, property is not only given away but frequently destroyed, in order to increase the reputation of the host for lavishness.

The most important exchange of gifts among primitives, sometimes the only important exchange, takes place in connection with marriage. Among some peoples, the husband's family pays a bride price to the wife's family; among others, the wife's family pays a dowry to the husband's. Frequently they exchange gifts. In any case, the amount paid is rarely a matter of bargaining. It is considered a point of honor to make it as large as possible.

The only services usually needed from outside the household are those of the shaman or witch doctor. It is understood that he works for a fee but the amount is not stipulated. The patient gives what he can and, if it is not enough, the witch doctor makes magic to the patient's harm. Some peoples have a rudimentary form of currency, such as dentalia, shell money, and some even hoe blades. But this currency is often handled on the gift system rather than being counted out as an exact price. Only when civilization reaches such a point that there is frequent trade with absolute strangers does BARTER become highly developed.

R. M. U.

PRIMITIVE LABOR. The shortage of essential supplies, the existence of a strong rivalry, the craftsmanship and vanity of the individual, together with the mold of tribal custom, made labor a sustained and arduous undertaking for the bulk of the primitive populace. Basic in the division of labor was the allotment of monotonous and repetitive labor to women—the men electing to undertake hunting, warfare and other dangerous but more exciting pursuits. Even this rule was not uniform. Taboos and customs surrounded each task and some of the tribal burdens, such as the care of domesticated animals, often fell upon the men.

Sex was not the only differential of primitive labor for caste systems were quite common. Exhaustive studies of the Northwest Coast Indians indicate the presence there of three classes, the nobles, the commoners and the slaves. The commoners consisted of the lowly freemen and the unprivileged kinsmen of the nobles. The slaves were captives. Out of this slavery doubtless grew the discipline of sustained work and, to some extent, the practice of considering most work debasing and menial.

Although the struggle for a livelihood was essential, among primitive peoples there existed no clear rationality or planning. "Primitive man is not a miser nor a sage nor a beast but in Tarde's happy phrase a peacock," Lowie asserts. To a Plains Indian, a brave's renown and dare-devil feats took precedence over sustained labor. Often, however, as among the North Coast Indians and the Banks Islanders, wealth accumulation furnished a motive.

C. E. W.

PRIMITIVE MUSIC. Music is a primary urge of mankind and some form of musical expression is found among all peoples. The music of primitive peoples is inherently associated with everyday life, with agriculture, hunting, courtship, games, worship of tribal deities, sickness, fasting, birth and death. Each class of song usually has its own peculiar rhythmic pattern accented by cries or howls, hand-clapping, striking of sticks, beating of drums or by other crude instrumental accessories and is almost invariably accompanied by dancing and frequently by pantomime. The song-dance combination affords an outlet for surplus animal spirits and its mesmeric effect stimulates emotional excitement and helps to maintain muscular and nervous energy. The music of primitive peoples is generally unpleasant to the civilized ear because of its successive octaves, fifths and in some instances seconds. Chords are unknown, the intervals serving merely as strengthened single tones. Tone figures are usually repeated many times and are generally minor. Instruments accompanying primitive music fall into three classes: wind, percussive and stringed. Wind instruments are made from reeds, grass, wood, bone, ivory, clay, horn and stone. Percussive instruments include clappers and rattles using pebbles, fruit stones or shells and innumerable varieties of drums and tamborines varying from hollow tree trunks to the African marimba made from gourds. Stringed instruments were an early development because of the almost universal use of the bow and display great ingenuity in the use of plant fibers and animal tissues.

PRIMITIVE PROPERTY. A complex system of ownership characterizes property relationships in primitive groups. Often such ownership was vested, not in the individual, but rather in the family or clan. It is difficult to list the fields in which property rights of a sort were recognized. Among some peoples, land was the subject of coownership; among others, it was an individual possession. A primitive communism in land is also frequently noted. And ordinarily the possession of land involved a complicated set of property interests, each recognized by custom.

The verdict of anthropologists appears to be that no single system of primitive property preceded all others. Probably there was no golden age of primitive communism, nor was private property the original basis. It is also not possible to generalize by showing that the rise of civilization is accompanied by the increasing recognition of private property. For many property rights have vanished with the changes in culture. And in many groups, such as the pre-Incas, an advanced state of development was reached within the intervention of private property as it is now known.

C. E. W.

BIBLIOGRAPHY.—A. A. Goldenweiser, *Early Civilization*; R. H. Lowie, *Primitive Society*; W. H. R. Rivers, *The History of Melanesian Society*.

PRIMITIVE WEAPONS. Modern military weapons have evolved through long periods from the simplest primitive attempts of man to defend himself

and his possessions or to overcome his enemies to increase his dominion. For throwing stones the sling was evolved, followed by catapults, ballista and cannon. For throwing sharp sticks and the javelin, the bow and arrow and the cross-bow were produced. The musket and the rifle succeeded them. For bruising, cutting and piercing, the hammer, the mace, the ax, the dagger, the sword, the spear, the lance, the pike and the bayonet were invented. For defense many forms of shields were made. The effectiveness of these implements in war depended upon the perfection of design, the expertness of the soldier and the tactical genius of the commander. Before the use of gun powder offensive action was conducted by infantry at close range, hurling its stones, arrows and spears, charging with its pikes, then casting aside all but the sword and shield, fighting hand to hand until one side gave way. Cavalry charged with the lance, then drew the sword for the final struggle. The attack was received upon pikes, the front rank kneeling, the rear rank standing and the archers behind them using their arrows.

About 1248 A.D. Roger Bacon recorded the composition of explosive powder. In the next century Bernard Schwarz, a German monk, fired a missile from a tube with this mixture. Crude cannon were used by the English at Crecy in 1346. The Italians produced a portable firearm about 1430. In another century, about 1540, the pistol, the single handed firearm for use on horseback, was manufactured at Pistoia, Italy. Very slowly, the portable firearm and the cannon replaced the bow and the catapult. The first musket or harquebus was fired by a slow match applied by hand to the priming powder. The firelock carried the slow match by a lever and trigger. The wheel lock knocked sparks with the serrated edge of a wheel from a pyrite stone into the priming powder. The flint lock struck the spark from the stone. Not until 1807 did the percussion cap begin to replace the flint. This cap used in the cartridge or primer in a modified form remains the means of discharging firearms.

Early firearms used round balls fired from smooth bore barrels. Grooves were used in Vienna in 1498. Difficulties in loading prevented the extensive use of the grooves or rifling and the long spinning missile until the American Civil War in 1861. The Minie bullet of soft material with the cupped base invented in 1849 reduced the loading difficulties, and the breech-loader solved the problem. Cannon evolved along with the SMALL ARMS from simple wrought iron, bronze or cast iron smooth bore tubes held in wooden frames to the powerful steel tubes (*see ORDNANCE*) on steel mounts of to-day. In 1453, at Constantinople, Mahomet II had huge short cast cannon firing stones weighing 600 pounds. Large bore, beautifully worked cannon were frequently used after that time until the desire for mobility forced the substitution of larger numbers with smaller bores. To spin the elongated projectiles, early cannon were made with twisted elliptical and hexagonal tubes, but the grooved bores were soon found more satisfactory.

Early projectiles were coated with lead to take the rifling, studs on the projectiles were tried, and later the present types of soft metal rotating bands proved to be the most satisfactory system. C. G. M.

BIBLIOGRAPHY.—W. W. Greener, *Gun and Its Development*; British War Office, *Textbook of Small Arms*.

PRIMO DE RIVERA, DON MIGUEL (1870-1930), Spanish dictator, was born at Jerez de la Frontera, Jan. 8, 1870. He became an army officer and served with distinction in Cuba and the Philippines in 1898. He criticized severely the conduct of military and political affairs in 1921. The next year he was appointed captain-general of Catalonia and ended a period of disorder there. After the coup d'état, Sept. 12-14, 1923, with the support of the army, he was accepted as dictator by ALFONSO XIII. The Cortes was dissolved, the Constitution suspended and the government placed under a Military Directorate of which Primo de Rivera was the head. Opposition was rigorously suppressed; many Republican and Liberal leaders were exiled or imprisoned. As a result, many conspiracies were promoted from abroad, mainly from Paris, during the six year period of Primo de Rivera's dictatorship.

The dictator's policy during his regime was an extensive program of public works, including the promotion and construction of railroads, highways, harbors and public buildings, while friendly commercial relations with other countries were begun. The greatest success of the Military Directorate was its securing French collaboration in dealing with the Moroccan situation and the overthrow of Abd-el-Krim by the combined Spanish and French forces in the fall of 1925. By the end of 1926, however, the Directorate was replaced by a government including civilian as well as military ministers; Primo de Rivera continued in control and carried on his policies. Much was done during the early part of his dictatorship toward the reform of municipal and provincial government. In Catalonia in particular this aroused opposition because of the separatist sentiment in that region.

Primo de Rivera had continual difficulty in keeping his army under control; mutinies of the Artillery Corps occurred in 1926 and 1929; in the latter year disaffection of the army became widespread. The National Consultative Assembly which he convoked in September, 1927, made no progress toward securing a satisfactory solution. Rapprochement along commercial lines with foreign countries was also checked by a high protective policy inaugurated in July, 1926. His favoritism for the Jesuit Schools created great opposition in some quarters, and in 1929 there was a great demonstration against him of the Liberal and Radical elements in Madrid. All these factors, combined with his increasingly poor health, made his fall inevitable and on Jan. 28, 1930, he resigned. He died in Paris, Mar. 16, 1930. R. W. P.

PRIMO FILICES, a term distinguishing a very ancient and varied group of true ferns, found only as fossils, from other Paleozoic ferns of ancestral type, such as *Osmundites* and tree ferns, which are more

or less clearly linked with living families. These early ferns range from later Devonian to Permian time. They are known chiefly by the anatomy of the stem, which is primitive in character, with a single vascular cylinder. They were relatively small plants, some with creeping rootstocks, others with short upright stems crowded with leafbases. In few cases do the rocks afford evidence as to foliage or fruiting habit.

PRIMOGENITURE, inheritance by the eldest son by virtue of seniority of birth. At common law it existed with respect to real property in estates in fee simple and estates tail. It has been abolished by statute almost universally, but exists in a few jurisdictions in case of estates tail to the extent that the eldest son of the tenant in tail will succeed as owner in fee simple.

PRIMROSE, a numerous genus (*Primula*) of perennial herbs of the primrose family including many highly prized garden and greenhouse plants. There are upward of 250 species found chiefly in hilly districts of the Northern Hemisphere; about 15 are native to North America. They are stemless plants with basal leaves and usually showy flowers borne mostly in umbels or heads. The true primrose or cowslip (*P. veris*), which bears bright yellow fragrant flowers, is cultivated in numerous floral varieties as is the similar oxlip (*P. elatior*).

The polyantha primroses (*P. polyantha*) comprise a garden group probably derived from hybrids of the cowslip, oxlip and the common primrose (*P. vulgaris*). Other garden favorites are the auricula primrose (*P. Auricula*) with numerous color varieties, the buttercup primrose (*P. floribunda*) with golden yellow flowers, the fairy primrose (*P. malacoides*), a white-mealy plant with rose and lilac flowers, and the China primrose (*P. sinensis*) with many double-flowered, crested and fringed forms in a wide range of colors.

PRINCE ALBERT, a city of Saskatchewan, Canada, situated on the northern branch of the Saskatchewan River, about 198 mi. north of Regina and 415 mi. northwest of Winnipeg. On the Canadian National and Canadian Pacific railroads and headquarters for the Brooks Airways, Prince Albert is the distributing point for the large farming area of northern Saskatchewan. Prince Albert has stockyards, a packing plant, creameries, flour mills, breweries and woodworking and box factories. It is also a fur-buying center and fresh and frozen fish are shipped. Lying in beautiful environs, and 35 mi. south of PRINCE ALBERT PARK, more than 1,800 sq. mi. in area, the city is a tourist and resort center and the headquarters of canoe, hunting and fishing expeditions. It is modernly built, with numerous schools, colleges, and public works, and a see city of the Anglican and Catholic churches. Prince Albert was founded in 1866 by Rev. James Nisbet, a Presbyterian missionary. Pop. 1921, 7,430; 1931, 9,905.

PRINCE ALBERT PARK, a Canadian national park established Mar. 24, 1927; area 1,869 sq. mi. It is approximately 30 mi. north of PRINCE ALBERT in

the province of Saskatchewan. The park is a wooded wilderness with innumerable lakes and streams forming connected waterways which provide canoe routes extending for hundreds of miles. It is also the water gateway to the Hudson Bay region and the Far North. Regulated fishing is permitted and the lakes are well-stocked with lake trout, whitefish, pike and pickerel. Wild animals include caribou, elk, deer, moose, bear and beaver, but all game is protected. The park is reached from the Canadian National railroad and also by an improved motor road from Prince Albert.

PRINCE AND THE PAUPER, THE, a book for boys by Mark Twain (*see* S. L. CLEMENS), published in 1881. This is the story, laid in England in the days of Henry VIII, of a poor boy, Tom Canty, who one day exchanges his rags for the embroidered robes of the Prince of Wales, and becomes suddenly the Prince and at length the King, while the true Prince lives as a pauper among the poorest of his subjects. After many adventures the Prince returns, and very gladly Tom sees him crowned King.

PRINCE EDWARD ISLAND, a province of Canada, surrounded by the waters of the Gulf of St. Lawrence, and separated from the mainland of New Brunswick and Nova Scotia by Northumberland Strait.

Area and Population. With an area of 2,184 sq. mi., Prince Edward Island is the smallest province in the Dominion. The length is about 130 mi. and the breadth from 4 to 34 mi. Pop. (1921), 88,615, a decrease from the previous census of 5,113; in 1931, 88,038. The inhabitants are mainly of British descent, but there are some descendants of American Loyalists and French Acadians.

Surface Features. The coast line, particularly on the south, is deeply indented with numerous bays and tidal inlets. In two places the converging waters are only a few miles apart, nearly dividing the province in three parts. The shore line measures 1,020 mi. The surface of the island is gently undulating without mountains or lowlands. The principal highlands are a range of hills stretching north and south across the province. Rivers are short and deep. The climate is healthy, bracing and milder than that of the neighboring mainland. The heat is not oppressive, seldom reaching 80° F.; winter temperature averages 17° F. Cape Breton and Newfoundland shelter the island from Atlantic fogs.

Natural Resources. There is not much deep-sea fishing from the island, although it is adjacent to one of the world's greatest fisheries. Fishing for lobsters provides employment to about 1,500 people of both sexes. The lobsters are trapped, cooked in factories, and the meat canned and exported to France, Great Britain and the United States. Oysters, scallops, smelts, herring and cod are caught in large quantities. The Dominion government has possession and control of the oyster beds, which extend over more than 15,000 acres.

The soil of the island is a bright red loam, passing into stiff clay on the one hand and sandy loam on the

other; as a large proportion of the entire area is crop land agriculture is the chief industry. Oats, potatoes, barley and maize are raised. Butter and cheese factories are scattered over the island; in 1927 there were 36, the total value of output being \$1,050,439.

Fox-farming on the island holds the premier place of the Dominion in this industry. Many live silver foxes for foundation stock are exported to the United States, other parts of Canada and Europe. Pelts are marketed at Montreal, London and New York. The value of fur-bearing animals on farms was estimated at \$4,500,000 in 1928.

Towns and Harbors. Charlottetown, the capital, has one of the largest pork-packing plants in the Dominion; Summerside is the center of the oyster trade; Georgetown is a seaport, and Souris an important fishing center. Charlottetown, Summerside and Georgetown provide good anchorage for ocean steamships, and Souris, Crapaud, Montague, Murray Harbour and Cardigan offer harborage for coastal vessels.

History. The island was discovered by JACQUES CARTIER in 1534, who thought it was part of the mainland. When its separate entity was established it was given the name Ile St. Jean (St. John Island) and it was thus known until 1799 when it received its present name in compliment to the Duke of Kent, who was commanding the British forces in North America and who later became the father of Queen Victoria. In the fierce struggle between England and France for the possession of New France, the island, although not the scene of actual conflict, frequently changed hands. In 1663 it was granted under feudal tenure to Captain Doublet of the French navy, who established a few fishery stations, but it was not until 1755 that there was any serious attempt at colonization. Many Acadians took refuge in the island when expelled from Nova Scotia. Upon the fall of Louisburg in 1758 the British invaded the island, and when their possession was confirmed by the TREATY OF PARIS in 1763 the island was annexed to Nova Scotia, but was constituted a separate colony six years later. In 1873 the province joined the confederation.

PRINCE IGOR, an opera in four acts, by A. P. BORODIN, libretto based on a twelfth-century chronicle by the composer; première, St. Petersburg, 1890, New York, 1915. Borodin left the work uncompleted, and it was finished by RIMSKY-KORSAKOV and GLAZOUNOV. Among Russian operas it occupies an important position.

Leaving his wife under the care of his brother, Igor, the prince of Seversk, goes forth to battle against the Polovtsy, an Oriental tribe. Prince Galitzky, Igor's brother, turns traitor and endeavors to seize the military power at home, aided by Eroshka and Skoula who have deserted from Igor's army. Meanwhile Vladimir, Igor's son, falls in love with the daughter of the Polovtsy ruler, Konchakovna, when Khan Konchak and his army have proved victorious, and take Igor and Vladimir captive. Igor and Vladimir attempt escape, but Konchakovna succeeds in stopping Vladimir, whose life is spared when Khan Konchak

decides he will make a good son-in-law. The lamenting Princess Yaroslavna is then restored to happiness by the return of her warrior-husband Igor.

PRINCE RUPERT, a port town of British Columbia, Canada, situated on an island near the mouth of Skeen River in Prince Rupert harbor, about 550 mi. north of Vancouver. The well-equipped, all-year-round harbor is the Pacific terminus of the Canadian National Railway, and an important port of the province, exporting large quantities of cod, salmon and halibut. Prince Rupert is the administrative center of an extensive mining and lumbering area, and has great grain elevators and fertilizer works. A well-built city, it was founded in 1908 by the Canadian National Railway and named for the first governor of the Hudson's Bay Company. It was incorporated in 1910. Pop. 1921, 6,393; 1931, 6,350.

PRINCE'S-FEATHER, the name given to several tall ornamental annuals of the AMARANTH family with showy spikes of pink or reddish flowers. The best known is a variety of the green amaranth (*Amaranthus hybrida* var. *hypochondriacus*), a native of the tropics and sparingly escaped in the United States. The name is also applied to a widely cultivated species of Polygonum (*P. orientale*), native to Asia and Australia and more or less naturalized in North America.

PRINCETON, a city in southwestern Indiana, the county seat of Gibson Co., situated 30 mi. north of Evansville. It is served by two railroads. This region has oil wells, coal mines and gas fields. The city is a trade center for the excellent wheat, fruit and cattle grown in the vicinity. The local industries include lumber and flour milling, railroad shop work and catsup and pickle making. Princeton was founded in 1814; chartered in 1884. Pop. 1920, 7,132; 1930, 7,505.

PRINCETON, a borough of Mercer Co., N.J., situated on elevated ground affording a view of the beautiful surrounding country, 45 mi. southwest of New York City. PRINCETON UNIVERSITY, Princeton Theological Seminary, Saint Joseph's College, and several preparatory schools make the borough desirable as a residential place. It is served by the Pennsylvania Railroad and motor buses operating over the Lincoln and "Super" highways. Princeton was settled in 1696, and the College of New Jersey (now Princeton University) was moved here from Newark in 1750. The town featured prominently in events of the Revolution (see BATTLE OF PRINCETON). The first legislature of the state met here in 1776. There are many fine examples of colonial architecture and a great number of places of historic interest including Nassau Hall, built in 1754, where the Continental Congress was in session at the time of Cornwallis's surrender. It was incorporated as a town in 1813 and as a borough in 1873. Pop. 1920, 5,917; 1930, 6,992.

PRINCETON, a city in southern West Virginia, the county seat of Mercer Co., situated in the heart of the Appalachian Mountains, 12 mi. east of Bluefield. It is served by the Virginian Railroad. Coal and timber, which abound in this region, and railroading,

are the chief industrial interests. Grain and garden truck are the principal crops, and many cattle are raised in the vicinity. Princeton has several factories. The city was founded in 1837 and incorporated in 1903. Pop. 1920, 6,224; 1930, 6,955.

PRINCETON, BATTLE OF, Jan. 3, 1777, an engagement of the REVOLUTIONARY WAR which resulted in an American victory. At the news of the BATTLE OF TRENTON, Gen. Cornwallis, taking 8,000 men from the British army stationed at Princeton, marched toward Trenton with the intention of capturing Gen. Washington. Washington's force at the time numbered 3,000. While the British were encamped before Trenton, Washington, keeping his camp fires burning all night to deceive the enemy, evacuated the town, deployed around the British army, and proceeded toward Princeton, where three regiments of British soldiery had remained. Gen. Mercer with his troops encountered just outside the city a detachment of British soldiers on their way to join Cornwallis. In the ensuing battle the Americans won a complete victory. The American casualties numbered about 100, including Gen. Mercer among the killed, against the British loss of 400.

PRINCETON, MOUNT, a granite peak in the Sawatch range of the Rocky Mountains in Colorado, rising to an altitude of 14,177 ft. It occurs just east of the Continental Divide and is part of the western front of the Arkansas River valley. With Mt. Harvard, Mt. Yale and Mt. Columbia, it forms the College group of peaks. Harvard and Yale were named in 1869 by J. D. Whitney, a professor at Harvard; Princeton was named a few years later by Henry Gannett; and Columbia in 1916 by Roger Toll.

PRINCETON UNIVERSITY, a privately-endowed university for men, at Princeton, N.J. It was chartered in 1746, through the efforts of the Presbyterian Synod of New York and the Presbytery of New Brunswick, after an earlier attempt, promoted by the Synod of Philadelphia in 1739, had failed. Adopting many interests of the recently closed Log College, near Philadelphia, the new institution was opened as the College of New Jersey in 1747 at Elizabethtown, N.J. Later in the year the college moved to Newark, N.J. In 1752 it was voted to move to Princeton, and four years later this last transfer was effected. Princeton during the Revolution missed but one commencement, that of 1777. It suffered greatly, however, during the Civil War. The system of elective studies was introduced in 1870. In 1873 the John Green School of Science was opened, which was followed by the Graduate School and later by the School of Electrical Engineering. The college in 1896 became the University of Princeton. It has in addition to 16 departments graduate courses in arts and sciences, a School of Architecture, a School of Civil Engineering and a School of Electrical Engineering. Since 1905 the preceptorial system has been in effect, by means of which an excellent personal relationship is established between professors and students. Princeton has no secret societies, but

upper-classmen generally belong to one of the numerous eating clubs. The system of dormitories is one of the largest and finest in the United States. The buildings at Princeton, chiefly built of gray stone in the Gothic style, are unified and uncommonly impressive. The endowment fund in 1931 totaled \$25,628,759. The library contained 650,000 volumes. In 1930-31 Princeton enrolled 2,527 students, of whom 250 were graduate students. The faculty of 331 members was headed by Pres. JOHN GRIER HIBBEN. The total assets were estimated at \$24,000,000.

PRINCIPAL AND AGENT, in law, a relationship between one person and another whom he authorizes to act for him. The principal is entitled to the results of all acts he authorized the agent to do. He takes the profits and he bears the losses. Should the agent exceed his authority, act outside of it, or be guilty of misconduct or gross negligence, the principal can exact from him indemnity for the resulting damages. To the person with whom the agent dealt the principal is responsible, although the agent has exceeded his authority, i.e., provided always there is no collusion between the third person and the agent. In common law the decisions were so strict and technical that in many localities statutes have been enacted to regulate conditions. Authority may be conferred in writing, without a seal, orally, or even by the mere act of employment. That is to say, it can be inferred from the acknowledged relations of the parties.

PRINCIPATE, THE, the name given to the new form of government established in Rome by Augustus in 27 B.C., a government in origin essentially constitutional, which, however, gradually developed into a military despotism and a monarchy almost absolute. The principate came into being when Augustus laid aside the exceptional powers granted to him as *triumvir respublicae constituendae* to bring order out of the chaos resulting from the civil wars preceding and following Julius Caesar's death, and on his own authority reinvested the senate and people with their customary powers. Although the sovereignty of the people was theoretically preserved, the real powers of the state were divided between the senate and the *princeps*. Because of this joint rule of the *princeps* and senate the early period of the principate has often been described as a diarchy.

The personal authority of Augustus was based chiefly upon the proconsular power and tribunician authority which were repeatedly voted him. By his proconsular power, which gave him precedence over all other magistrates, he was enabled positively to guide the policies of the state, and by his tribunician authority he could block all measures contrary to his interest. At the same time he surrounded himself with the odor of sanctity attached from time immemorial to the person of a tribune.

Unwilling to carry through the autocratic policies of Julius Caesar to their logical conclusion Augustus granted legislative and judicial power to the senate greater in extent than the senate had enjoyed even

in republican times. On the other hand by active interference in the elections of magistrates Augustus carefully controlled the senate, as election to one of the regular magistracies, such as the quaestorship, praetorship, or consulship, was a condition of eligibility for membership in the senate. Wishing to give the senate an active part in the administration of Roman territory beyond the limits of Italy, and at the same time determined to control the frontiers of the empire and the legions stationed in the outlying provinces through governors directly responsible to himself alone, Augustus divided the provinces into two categories, senatorial and imperial. The senatorial provinces were known either as consular or praetorian. The two most important, Asia and Africa, were consular, while Bithynia, Cyprus, Crete and Cyrene, Achaia, Macedonia, Sicily, Sardinia and Corsica, Narbonensis and Baetica were praetorian. That is the governors of Asia and Africa had to be ex-consuls, whereas ex-praetors might govern the others. They were chosen by lot and served either for one or for two years. The imperial provinces, namely Syria, Moesia, Pannonia, Dalmatia, Upper and Lower Germany, Tarraconensis, Pamphylia, Galatia, Aquitania, Lugdunensis, Belgica and Lusitania, were governed by legates appointed by the *princeps*. To these legates, often ex-consuls and ex-praetors, was entrusted the defense of the frontiers, and to promote military efficiency they were often continued in office for many years. Egypt was never regarded as a province of Rome, but rather as the private estate of the *princeps*. In general the administration of public finance was divided between the senate and the *princeps*, assisted by financial experts belonging to the equestrian class.

Theoretically the *princeps* had no authority to transmit at his death his power to the successor of his choice. Actually he showed his wishes by bestowing during his lifetime powers parallel to his own upon the man whom he wished to be his successor in the hope that on his death the senate would formally accept this man as *princeps*. As time went on, however, orderly succession was frequently prevented by a poor choice of a successor on the part of the ruling *princeps*, by the senate's refusal to accept the choice, by the interference of the praetorian guard, or by the rival ambitions of legates in the provinces. The tendency of the soldiers more and more to dominate the imperial succession and their refusal to accept the decision of the senate in Rome ended in civil wars and violences reaching their culmination in the 3rd century A.D., when Diocletian, frankly recognizing the impossibility of a constitutional government, established an undisguised military despotism.

G. M. H.

BIBLIOGRAPHY.—E. S. Shuckburgh, *Augustus*, 1905; M. Rostovtzeff, *Augustus*, 1922; T. Rice Holmes, *The Architect of the Roman Empire*, 1931.

PRINCIPLES OF THE PEOPLE, THREE. See THREE PRINCIPLES OF THE PEOPLE.

PRINTING. Three commercially useful methods of printing are recognizable. The oldest and most

important is the letterpress or relief surface method. The plate or form prints from the raised portions, the sunken parts, not being inked, representing the white portions of the printed matter.

The planographic process, or LITHOGRAPHY, is based upon affinities. If a design is traced upon the dressed surface of a suitable stone in a water resistant medium, and the stone is dampened, the lines of the design will remain dry, with an affinity for only ink. By rolling the surface alternately with water and ink, a condition can be maintained which will be very satisfactory for printing. Offset printing employs this principle, substituting for the stone a treated aluminum plate for use on rotary presses. The print is not made on the stock but on a rubber surfaced cylinder which offsets it on the paper.

The third process is from the intaglio plate, recognizable in steel and copperplate engraving and in gravure. The plate is the exact opposite of the relief plate, the low portions printing the color. The design is engraved or etched in grooves and pits. Ink is flooded over the plate, then wiped off the surface portions, leaving the lines and pits filled. During impression, the ink adheres to the stock and is lifted out of the recesses of the plate. See also COLOR PRINTING; FOUR-COLOR PROCESS. E. W. P.

PRINTING, TEXTILE, the process of printing designs of one or more colors on textiles. Printed designs are produced chiefly on woven fabrics, and to a lesser extent on knit goods and yarn. Synthetic dyestuffs, such as are used in DYEING, are the principal coloring matters employed.

In block printing, which is the oldest method, the color is stamped with the design in relief. Printing by means of the roller machine is the most widely used method. In this process, the color, which is mixed with STARCH, dextrin, or gum, and water to form a paste, is applied to the cloth by means of an engraved copper roller. For each color in the pattern or design a separate roller is required. As the back of the fabric passes over a large central cylinder, the color which is held by engraved copper rollers which revolve against the face of the goods is transferred to the cloth; the goods are then dried, steamed, soaped, and washed. In duplex printing both sides of the fabric are printed either in the same or different designs and colors.

Three common types of printing are: (1) direct printing, where the color is applied directly to the fabric to form the design in the manner outlined; (2) discharge printing, in which the goods are first dyed in the usual manner and are then printed with chemicals which cause the color to be destroyed, or discharged, in those portions with which they come in contact; and (3) resist printing, in which the fabric is printed with materials which either have no affinity for dyestuffs or have a destructive action on the color, so when the goods are dyed, a white pattern, or resist, results.

Yarn in the form of skeins or warps; slubbing; and hosiery and other knit goods are printed with

the aid of special equipment which make it possible to produce colored designs on any desired part of the material.

W. W. C.

BIBLIOGRAPHY.—E. Knecht and J. B. Fothergill, *The Principles and Practice of Textile Printing*.

PRINTING AND PUBLISHING INDUSTRIES, UNITED STATES. Printing and publishing, together with several closely allied activities, are classified by the Census of Manufactures as one of the 16 major groups of American industries. Of the total output for 1929 amounting to \$3,170,139,651, printing and publishing contributed 87% and the allied industries, as book-binding, photo-engraving, engraving, lithographing and stereotyping, 13%. The printing and publishing industries proper, with an aggregate output valued at \$2,760,195,928, comprised three separately reported groups of products with values as follows: (1) newspapers and periodicals \$1,738,298,892, (2) book and job \$1,006,656,768, and (3) music \$15,240,268. Although these industries are represented in every state, about 42% of the total output was produced by eight leading states as follows:

State	Value of Products \$	% of Total	State	Value of Products \$	% of Total
N. Y. . . .	719,918,735	26.1	Calif. . . .	144,353,946	5.2
Ill.	355,748,319	12.9	Mass. . . .	140,481,332	5.1
Penna. . .	266,155,681	9.7	Mich. . . .	100,117,017	3.6
Ohio . . .	202,024,630	7.3	Mo.	83,859,683	2.4

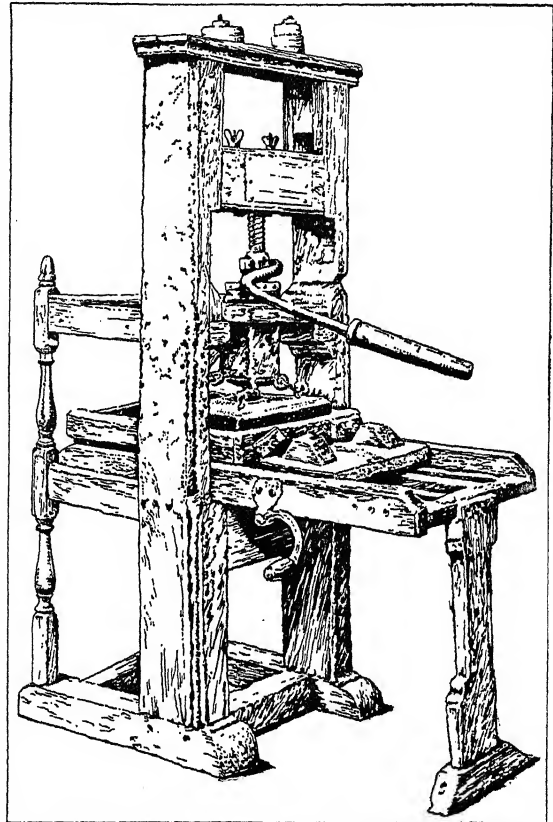
Throughout the three decades, 1899-1929, there was a remarkable expansion in the printing and publishing industry. Statistics concerning important features of this growth are given in the accompanying table.

PRINTING AND PUBLISHING, U.S., 1899-1929

Year	No. Establishments	Wage Earners	Wages \$	Value of Products \$
1899	22,326	163,827	84,512,213	347,616,783
1904	26,448	186,262	109,327,177	498,326,482
1909	29,784	219,018	141,768,720	665,202,673
1914	31,637	229,442	168,125,218	813,534,097
1919	30,630	244,688	287,125,883	1,537,936,665
1925	21,072	252,515	440,427,479	2,283,303,640
1929	24,360	281,119	506,290,168	2,760,195,928

PRINTING PRESSES. The earliest types of presses delivered impression from a platen lowered by a screw laboriously turned by hand. Power application was the same in a later press where a system of toggle levers replaced the screw. Early job presses were driven by a foot treadle, and the first cylinders were operated by cranks. The steam presses of Civil War days marked the first important departure from manual motive power. In the smaller shops lever-operated upright embossers and copper-plate engraving presses are likely to be the rule, but the larger plants have motorized even the proof presses. Individual electric power units are widely favored. Hand feeding is still widely practiced, but automatic feeders are rapidly claiming both cylinders and platens.

Modern Printing Presses. According to the mechanical method by which the impression is delivered, there are three classes of printing presses: platen; cylinder; and rotary. In the case of the platen press the impression is delivered by a flat plate meeting a level printing form. Numberless devices have been used, the earliest and simplest being the lowering of a horizontal platen by means of a screw. Modern refinements use a wide variety of levers, cranks and cams



PRINTING PRESS AT WHICH BENJAMIN FRANKLIN WORKED AT WATT'S PRINTING OFFICE, LONDON, IN 1725

to secure the same result, besides a number of accessory mechanisms.

In the use of the cylinder press, the paper is carried on a revolving cylinder, delivering the impression to a flat printing form on the bed of the press. In this method there are wide mechanical variations. The cylinder may roll back and forth over a stationary bed, or the bed may oscillate beneath a cylinder on a fixed axis, or both may oscillate to complete a printing cycle. The bed may be on a horizontal, vertical or inclined plane. In a printing cycle the cylinder may revolve once, twice, or stop for half the cycle. The greater amount of fine printing is done on cylinder presses.

Curved printing plates are necessary for the rotary press. The paper-carrying cylinder delivers the impression to a bed cylinder on which the plates are secured. There are many types of the rotary press, in-

cluding the great newspaper presses, some of which are capable of almost incredible production.

According to the manner in which the paper is handled, presses may be sheet or WEB. Any type of mechanical principle may be adapted to either form, but the platens use sheets to best advantage, while rotaries are best adapted to paper in web.

According to the condition of the printed sheet, presses are singles and perfectors. Singles print only one side of the sheet, the operation being repeated to print the other side. Perfectors are compound machines that print both sides at one operation. Newspaper presses are rotary web perfectors.

Classified according to another scheme, presses are singles or color machines. Singles print only one color at a time, but are capable of multicolor work by successive workings of the sheet with changed plates and INK. Multicolor presses are compound machines, each section being equipped to carry appropriate plates and inks, with two to eight possible colors.

Another classification would be based upon the kind of PRINTING surface employed; e.g., letter press, planographic and intaglio. Specialization in product further diversifies and extends any classification scheme almost ad infinitum.

Feeders are the parts of printing presses which furnish the separate sheets for the impression. In doing so, they separate the sheets, advance them to the guides, and register them in position. Platen feeders must also deliver the printed sheet. One method of separation is to blow a blast of air between the sheets, floating the top one loose from the pile. It is then lifted by vacuum cups and advanced to cam or tape conveyors that deliver it to the guides. Grippers then seize the sheet and pull or push it into register position. Another method applies lateral friction to the pile, slipping the top sheet forward and fanning the sheets until the successive top sheets present margins wide enough to be gripped singly and drawn to the conveyors. High speed feeding must provide for diminishing sheet motion, or the sheet will crumple when it strikes the guides.

E. W. P.

PRINTING TYPE. See TYPE, PRINTING; POINT SYSTEM.

PRIOR, MATTHEW (1664-1721), English poet and diplomat, was born July 21, 1664, probably at Wimborne, East Dorset. He was educated at Cambridge, and became secretary to the embassies at The Hague and at Paris, and under-secretary of state. Elected to Parliament as a Whig in 1701, he went over to the Tories, and later, 1715-17, was imprisoned by the Whigs. Among his writings are *The City Mouse and the Country Mouse*, written with Charles Montagu, and his collected poems. Not a great poet, Prior was however a gifted occasional poet and is noted for his humor. He died at Wimpole, Cambridgeshire, Sept. 18, 1721.

PRIOR, in monasteries, the first or second in authority; in Benedictine cloisters, the head of a branch cloister, who is subordinate to the abbot of the mother-cloister. In some other religious orders

it has the same significance as abbot, and corresponds to the rank of prioress in convents. A priory is a monastery under a prior and also the totality of the monasteries under a prior's supervision.

PRISCILLA, in Longfellow's *Courtship of Miles Standish*, is wooed by Captain Standish through John Alden. Priscilla's comment on the suit is "Why don't you speak for yourself, John?" She and Alden marry, and Standish becomes reconciled.

PRISM, a solid figure in which two ends, the upper and lower bases, are congruent and parallel rectilinear figures and whose sides are parallelograms. The most common form is a rectangular parallelepiped; for example, an ordinary box. See SOLIDS, GEOMETRIC.

PRISM, OPTICAL, an optical component made of glass, or other transparent material, bounded by plane surfaces. Prisms may be used to disperse light (see DISPERSION) in order to produce a SPECTRUM. A prism composed of two or more components which disperse the light but permit some ray in the spectrum (see LINE SPECTRUM) to remain undeviated is termed a *direct vision prism*. In optical instruments not intended for spectroscopic purposes, prisms are commonly used to deviate light without dispersion. In most cases, such deviation is produced by total internal REFLECTION at one or more of the prism faces. These prisms are termed *reflecting prisms*. The prism binocular (see BINOCULAR INSTRUMENTS) contains two prisms in each barrel and two reflections occur in each prism. These prisms serve to erect the image.

I. C. G.

PRISMATIC COEFFICIENT, the ratio between the volume in cubic feet of the DISPLACEMENT of a vessel and a solid having the same midship section and the same length used in calculating the displacement.

PRISON ARCHITECTURE. The erection of buildings designed to serve as prisons for the incarceration and punishment of criminals is a practice dating only from about the 17th century. In medieval times, the keep or dungeon of a castle frequently contained cells where malefactors awaiting trial or punishment were kept. A gradual change to the theory of imprisonment as punishment occurred during the 15th and 16th centuries. Since this period coincided with the rise of centralized governments and the suppression of feudal warfare, some of the old royal fortresses, such as the Tower of London and the Bastille, were converted into state prisons. This expedient set an unfortunate precedent for the architectural character of all subsequent prisons. The first prisons, a few isolated examples, were built in the 16th century, and an increasing number in the 17th; but it was not until the latter part of the 18th century that the treatment of crime by imprisonment became so general as to produce extensive prison systems.

The Pennsylvania and Auburn Plans. Reforms introduced at this time provided for a crude classification; these general groups were confined separately, but there was no attempt to prevent contact between individuals within the same classification. By

the beginning of the 19th century, penal opinion began to favor a single cell for every prisoner. In the second decade of the century, two prisons were built in the United States which were destined to set the type for all European and American prisons for the next 100 years. One was in Philadelphia; it carried the theory of solitary confinement to its ultimate limit, the prisoner sleeping, eating and working alone in his cell. The cell house was a long and narrow building with an aisle down the middle and a row of cells on either side; the cells themselves were quite large. The other prison was at Auburn, N.Y.; here solitary confinement was at night only, prisoners working together in the shops during the day. For sleeping quarters, the designers of Auburn devised what is termed the interior cell block; the cells in several long tiers were placed back to back and the whole block thus formed was enclosed within another building. Since cells were to be used only for sleeping, they were reduced to the absolute minimum in area, viz., 3 ft. 3 in. x 7 ft. These two plans, known as the Pennsylvania plan and the Auburn plan, respectively, attracted world-wide attention and were the subject of much debate. Foreign commissions favored the Pennsylvania plan, and many subsequent European prisons have been of this type architecturally. But the American states preferred the Auburn plan, and the interior cell block became the universally accepted type for the American prison, even in Pennsylvania. For almost a century these two plans, with progressive refinements but with no fundamental changes, held undisputed sway in their respective countries.

The principal changes in the cell block were the installation of modern plumbing and the use of an ever-increasing quantity of so-called tool-proof steel and of complicated locking devices. The cells were made slightly larger, with the result that overcrowding frequently forced two or more prisoners into a cell designed for only one. Single institutions grew to enormous proportions, some having a prison population of more than 5,000. But the intelligent public's attitude changed toward the purpose of prisons. The removal of the dominant idea of punishment brought the prisoner many of the ordinary amenities of human life, formerly forbidden, but brought no decrease in efforts towards security.

Economic Factors Change Architectural Style.

Despite the revolutionary changes which had occurred in modern penology, the old interior cell block type of prison was so deeply entrenched in this country that efforts to change it might possibly have been hopeless, but for the intervention of a powerful economic factor. In the last decade, American prisons faced the problem of building additional prisons for the overflow, as well as rebuilding the old institutions. But construction costs for the standard interior cell prison had risen so high, \$5,000 to \$6,000 per prisoner, as to be absolutely prohibitive for an extensive building program. An analysis indicated that the greater part of it went into such non-productive ends as tool-proof steel, complicated locking devices, and the con-

struction and guarding of the wall. Yet the number of prisoners who require such precautions is very small, not over 15% of the total.

The system of classification of the modern penologists enables the architect to concentrate his efforts for security on the small group which needs it. Removal of the requirements of strict security for 80-90% of the prison population enables the architect to use dormitories for the majority of prison housing. They are preferred whenever possible because of the great saving in cost and because they give the prisoner training in cooperation with his fellowmen. A completely graduated scale of housing is provided: a small number of strong cells for the really dangerous; less secure cells for those not necessarily dangerous, but unable to live peaceably with their fellows; dormitories for the great majority, and a few single rooms and small wards for the better type of men who want privacy for study. The modern prison is much smaller than the old institution; 500 prisoners is the ideal and 1,000 the maximum. It has a complete hospital and reception unit, including the classification clinic and the quarantine cells, where new prisoners are kept during the period of examination and observation. It has increased facilities for instruction, study, exercise and recreation.

Typical Modern Prisons. One of the earliest modern prisons was the Westchester County Penitentiary, New York, built in 1915. This might be called the first medium security prison. All cells are outside, cell doors are of wood, and there is no wall. The building is all under one roof and designed to form enclosed courts, so that the more dangerous prisoners can be housed on the court side. The Federal Penitentiary at Lewisburg, Pa., and the New York State Prison at Wallkill are further developments of the same plan. Another early design of importance was that of the District of Columbia Reformatory at Lorton, Va., 1919. This was one of the first minimum security prisons: one-story brick dormitories, with no locks, bars, or prison walls. This prison has been the inspiration of many open-type prisons, especially reformatories and prison farms.

A unique example of the consistent planning of a prison according to modern penal theory is to be seen at the Massachusetts State Prison Colony at Norfolk. Believing that the criminal is an individual who is socially maladjusted and that the treatment for this is to place him in a controlled community as nearly normal as the exigencies of supervision will permit, the prison at Norfolk was accordingly designed as a small community. The houses are grouped about the "village green," in the center of which are the community buildings: the auditorium, hospital, school and jail, the latter containing the only strong cells in the prison. Houses are for 50 men each, in single rooms and small dormitories; each house has a combined living-room and dining-room, and all meals are taken there.

A radically new plan which may have an important influence on future prison design is the 12-story

Women's Detention Prison in New York City. The wide possibilities of the skyscraper prison are interesting subjects for speculation; whether this plan will be extensively employed in all types of prisons, or will be confined to the large cities remains for the future to answer.

J. H. C.

See R. L. Davison, "Prison Architecture," in *Architectural Record*, Jan 1930

PRISONER OF CHILLON, THE, a poem by LORD BYRON, published 1816. It is based on the life of François de Bonnavard (1496-1570), a prelate and ardent patriot of Geneva. Because of his political beliefs, de Bonnavard was imprisoned for six years by Charles III, Duke-Bishop of Savoy, in the castle of Chillon on Lake Geneva.

PRISONER OF WAR, an individual forming a part of or attached to a hostile army for active aid who by capture or surrender has fallen into the hands of the opposing belligerent. As a public rather than a private enemy, he is deprived of his liberty pending parole or exchange. Under the law of war, supplemented by international convention, prisoners of war are entitled to be treated with certain well-defined consideration.

BIBLIOGRAPHY—Geneva Convention of July 27, 1929, relative to the Treatment of Prisoners of War, Winthrop's *Military Law and Precedents*, U.S. War Dept., *Rules of Land Warfare*.

PRISONS, institutions designed to punish criminals by confinement at hard labor. In this sense prisons are of modern origin, though stockades, dungeons, and jails for accused and debtors date from early historic times. Until about 1800 it was the rule to punish criminals by corporal punishment or fines. The Quakers were chiefly responsible for the establishment of modern prisons, because they were repelled by the shedding of blood in corporal punishment. They tried to establish prisons in New Jersey and Pennsylvania in the last quarter of the 17th century, but the British government prevented this. Prisons came into being at the close of the eighteenth century, the United States taking the lead. The two model prisons were the Auburn, N.Y., prison, opened in 1819, and the Eastern Penitentiary at Philadelphia, opened in 1829. The Auburn system allowed convicts to work in congregate shops during the day but confined them in separate cells at night. In the Pennsylvania system each convict was kept isolated in an individual cell at all times. The Auburn system proved most popular in the United States; the Pennsylvania system in Europe.

The theories underlying the punishment of criminals have been fourfold. In primitive society punishment was based both upon social revenge and disapproval. During most of historic society, social revenge dominated. In modern times, the notion of deterrence through painful example became most popular. In the last generation the conception of social protection came to the fore. Modern criminologists and penologists recognize that no theory of vindictive punishment is valid. Instead of seeking a

specific punishment to fit a given crime they hold that an appropriate treatment to cure each reformable criminal should be prescribed.

Most prison administration has been brutal and repressive. Wardens and guards have been untrained, and solely concerned with the safe custody of their convict wards. Rules, counting, stripes and lockstep have dominated administration. No sense of self-responsibility has been encouraged. Severe regimentation, restraint and denial have dominated prison administration. But a new note was sounded by Thomas Mott Osborne in his Mutual Welfare League at Auburn, Sing Sing and Portsmouth. In this self-government scheme, not yet widely adopted, the convicts were allowed to run their own democratic community and were taught the responsibilities of citizenship.

The first type of sentence was a flat time sentence which the convict had to serve out. Then came maximum and minimum sentences, the convict being eligible to parole when his minimum sentence was up if his behavior had been good. Since the beginning of the century there has been a demand for the strictly indeterminate sentence. Here the judge merely sentences the convict to prison and the prison or parole authorities determine when he shall be released. But a thorough indeterminate sentence has rarely been adopted. Usually some minimum—often a year—is insisted upon. Commutation of sentence differs from the indeterminate sentence. In the former a flat time sentence is imposed but the convict may reduce it through good behavior.

The parole system has gradually been introduced in the present century. It began about 1850 in Ireland, and permits convicts to be released under supervision previous to the end of their sentence if their behavior warrants such action.

H. E. B.

BIBLIOGRAPHY—C. Bacon, *Prison Reform*, 1917; T. M. Osborn, *Prisons and Common Sense*, 1924; H. E. Barnes, *The Story of Punishment*, 1930.

PRISTINA, capital of the Yugoslav district of Kossovo on the eastern border of the famous plain, Kossovo Polje, in a fruitful, well-cultivated region. It is the seat of a Greek bishop, has a large number of mosques and several churches. The Kossovo Polje is noted for two bloody battles, one in 1389 between Murad I and the Serbs, under their Emperor Lasar, in which both rulers were killed and the freedom of the Serbs annihilated. In the other, 1488, John Hunyadi, guardian of the Hungarian King Vladislav Posthumus, was conquered by Sultan Murad II and taken prisoner by the Serbian Prince George Brankovics. Near Pristina are the ruins of the magnificent abbey, Gratschanitz. Most of the inhabitants are Mohammedans. Pop. 1931, 16,948.

PRITCHETT, HENRY SMITH (1857-), American educator and astronomer, was born at Fayette, Mo., Apr. 16, 1857. After graduating from Pritchett College, Glasgow, Mo., in 1875, he studied astronomy with Asaph Hall in the United States Naval Observatory. In 1878 he was made assistant

astronomer and two years later became astronomer at the Morrison Observatory in Glasgow. He was a member of the expedition to New Zealand in 1882 to observe the transit of Venus. From 1883-97 he was professor of astronomy and director of the observatory at Washington University. The following three years he was superintendent of the United States Coast and Geodetic Survey. From 1900, when he was elected president of Massachusetts Institute of Technology, his interests were turned primarily to education. His policies had a strong influence in shaping the trends of higher education, particularly during his long term of service, 1906-30, as president of the Carnegie Foundation for the Advancement of Teaching. Among his writings are *The Power That Makes for Peace*, 1907; *A Comprehensive Plan of Insurance and Annuities for College Teachers*, 1916; and *What Is the Matter with the Railways?*, 1923.

PRIVATE, in a military sense, any soldier who does not rank as an officer. When privates serve in a special capacity, as mechanics, horseshoers, trumpeters, musicians and the like they are so designated on the rolls and usually receive additional pay. Privates who are particularly capable and well disciplined are usually ranked as privates first class or privates second class.

PRIVATEER, a privately owned and operated vessel, commissioned by a state to carry on hostilities against an enemy state at sea. They, like belligerent cruisers (see **BELLIGERENCY**) were supposed to respect the laws of war. The practice degenerated into a prosperous but lawless calling for a number of people. England and France decided at the outbreak of the Crimean War that they would rely on armed ships alone. At the peace conference concluding the war, the Declaration of Paris was adopted, the first article of which abolished privateering. The United States refused to sign the declaration unless private property at sea was exempted from capture. C. E. MA.

PRIVATE INTERNATIONAL LAW. See **CONFLICT OF LAWS**.

PRIVATE PROPERTY, an exclusive right to own and control anything, whether tangible or intangible, according to the rules and customs accepted by the governing authority of an area. Subordinate in primitive society, private property now occupies, under capitalistic organization, a predominant position. The origin of private property is unknown—certain it is, however, that there is no Law of Nature or social contract, by which the instrument was inaugurated. Instead, one discovers that at varying times and places, different items came to be treated as being exclusive possessions. Weapons, ornaments, slaves, land and instruments of toil appeared as property early in history.

Property in land took varying forms according to the practices of cultivation. Title was often vested in kinship groups who jointly undertook the raising of crops. Under the feudal system, property rights became crystallized in such a form that custom dictated the income and property rights of each person

in the economic scheme—including the feudal hierarchy.

Under the modern English and American law, a distinction is made between personal and real property, based doubtless on the feudal system of land tenure. The distinction is today vital mainly in the differences in the rights of inheritance and succession, and in the different method by which title is passed. In the case of personal property, mere delivery suffices while formal instruments are necessary for passing title on land.

With the rise of the modern corporation, which is a legal person with ownership rights, the concept of private property has taken new forms. **PATENTS**, **COPYRIGHTS** and good will have become increasingly important. A judiciary favorable to the extension of property interests has, in the last 30 years through a broad interpretation of the 5th and 14th amendments to the Constitution of the United States, limited the sphere of governmental and trade union interference with the right to do business in the accustomed manner. Labor legislation has thus been often held unconstitutional while trade unions (see **LABOR ORGANIZATIONS**) have been enjoined from interfering with the access of the employer to the **MARKET**, on the ground that this violated a constitutional property guaranty. See also **PRIMITIVE PROPERTY**. C. E. W.

BIBLIOGRAPHY.—R. H. Tawney, *The Acquisitive Society*; E. H. Warren, *Selected Cases and Other Authorities on the Law of Property*.

PRIVATE SCHOOLS. The early private schools in the United States were called Latin grammar schools. Their primary object was to prepare boys for entrance to college. The academy was a later development and was usually founded by private endowment. A few were open to girls as well as boys. Another type of private school was established under the auspices of a church. (See **PAROCHIAL SCHOOLS**.) Though the scope of these later groups was broader than the early Latin grammar school, their chief aim was and still is to prepare students for college. The establishment of public high schools in 1821 did not for many decades affect the prosperity and growth of private institutions. In 1890 40% of all the secondary schools in the United States were still private. Since then, however, the proportion has constantly decreased until in 1930 only about 10% of students attended private schools. Though the proportion has decreased, there has been a steady, slow growth in actual numbers. In 1920 there were 2,034,642 students in private elementary and secondary schools, and in 1928 there were 2,576,157.

There has been considerable criticism of private schools in the United States, the main arguments against them being that they are too conservative and are not meeting the needs of the present day, and that they tend to destroy the democratic spirit. The contention of advocates of private schools is that they are able, on account of the smaller number of students, to treat them as individuals instead of mass groups and thus develop their abilities to the greatest degree.

More recently many private schools, which are not parochial or preparatory, have become centers of the progressive education movement. M R.

See P E Sargent, *Handbook of American Private Schools* (annual).

PRIVET, a genus (*Ligustrum*) of woody plants of the olive family many of which are grown for ornament, especially for hedges. There are about 50 species natives of Asia and Australia, a single species occurring in the Mediterranean region. They are deciduous or evergreen shrubs or rarely small trees with opposite entire leaves, small white flowers in terminal clusters and round, berry-like, usually black fruits (drupes). The common privet or prim (*L. vulgare*), a native of the Old World and more or less naturalized in eastern North America, is widely cultivated in numerous varieties. The California privet (*L. ovalifolium*), native to Japan, is also grown in many varietal forms.

PRIZE AND PRIZE COURTS. Shipping or other property seized, under the law of war, by a belligerent, on the high seas or in the territorial waters of either belligerent, is known as prize. Lawful prize becomes the property of the belligerent whose vessel of war effected the capture. However, the mere seizure of a merchant vessel and cargo vests no more than an inchoate or conditional title. Transfer of title does not become complete until after the alleged prize has been brought within the jurisdiction of a prize court of the captor's state and that court has passed affirmatively upon the legality of the capture.

It therefore becomes the duty of the captor promptly to convey the capture to a home port in which a prize court is sitting. With the prize, the ship's papers, log book, bills of lading and the like, are delivered into the custody of the court. Under the constitution and statutes of the United States the Federal courts are invested with jurisdiction "of all prizes brought into the United States; and of all proceedings for the condemnation of property taken as prize." In passing upon the legality of capture prize courts apply the principles of INTERNATIONAL LAW. See also CONTRABAND; VISIT AND SEARCH. E. A. K.

BIBLIOGRAPHY—C H. Stockton, *Outlines of International Law*; L. F. L. Oppenheim, *International Law*.

PRIZE MONEY, proceeds of the sale of captures made as prizes by government authority. Vessels and their cargoes captured as prizes must be sent into port for adjudication in a prize court in the manner prescribed by law. The property in a prize does not pass to the captor until it has been adjudicated upon. If condemned, the property is sold, and the proceeds, when the capture is made by a vessel or vessels of the Navy, are disposed of according to the decree of the court. If the prize was of equal or superior force to the vessel or vessels making the capture, the whole of the net proceeds went to the captains under certain adjudged rules. Otherwise one-half went to the Government. By Act of Mar. 3, 1899, prize money, as far as the United States is concerned, was abolished.

R. E. C.

PRIZREN, a town of Macedonia, YUGOSLAVIA, located in the Shar mountains. In the 12th century, the town was the residence of Serbian kings, but, falling into the hands of the Turks, for centuries it was the capital of the Turkish vilayet of Kossovo. In 1912 the Serbs again gained control of Prizren. Although the Treaty of Bucharest confirmed their possession in the following year, it fell to the Bulgarians during the World War. It was restored to the Serbs in 1918. One of the numerous mosques was a Byzantine cathedral at one time. Prizren has extensive bazaars and deals in steel and copper goods, glass, flint and leather. Pop. 1931, 18,952.

PROA. See BOAT.

PROBABILITY, in its most restricted sense, is the relation between all of the positive instances of a phenomenon and the total number of instances, both positive and negative. Counter probability is the relation between all of the negative instances and the total. Positive instances are those where the phenomenon, or what is expected, is present; negative instances, those where it is not. In throwing dice, if double sixes are expected, the number of times they appear in a given number of throws will be positive, and all other throws will be negative instances. It can be deduced from the nature of a pair of unloaded dice that the probability of double sixes is $1/36$ and the counter probability $35/36$. This is called theoretical probability because it is obtained by deduction. But suppose that in 500 throws double sixes have appeared 15 times. Then the probability is $15/500$ and the counter probability $485/500$. Since this ratio is obtained by actual enumeration, it is called experiential probability.

Law of Probability. The English logician, Jevons, and the Frenchman, Quetelet, made an important discovery by checking up on theoretical probability with experiential probability. Jevons tossed a coin 20,480 times and got 10,353 heads and 10,127 tails. Quetelet made 4,096 drawings from an urn containing 20 black and 20 white balls and got 2,066 white and 2,030 black balls. Thus they found that experiential probability approaches the exact ratio of theoretical probability when an extremely large number of cases are observed. The law of probability has been expressed: While in a small number of cases there is irregularity in the observed ratio between the number of times a given event has happened and its failures, still in a large number of instances this ratio tends towards a constant limit. As a result of the discovery of this law it is now possible to determine the theoretical probability, for all practical purposes, of those kinds of material which are of such a nature that it is impossible to deduce it, and this has had important practical consequences. For example, the whole modern development of life insurance is based upon it. The methods used to determine probability are sampling and statistics.

Probability Relation. Certain contemporary logicians use the word probability in a much wider sense than the one just explained when they define

it as "a relation, essentially indefinable, between any proposition and the evidence which supports it." (J. M. Keynes). This is called the probability relation to distinguish it from the relation of implication. When a true proposition is used to infer another we have the relation of implication. If things equal to the same thing are equal to each other then 2 plus 1 and 1 plus 2 are equal since each equals 3. This is strict implication. At the opposite extreme would be complete logical irrelevancy between two propositions. The probability relation covers all cases between strict implication and logical irrelevancy. Hence it varies in degree. In relation to one piece of evidence the degree of probability may be greater than in relation to another piece, when the same proposition is involved. All our conclusions about matters of fact lack the certainty of strict implication and possess varying degrees of probability, depending on the evidence used to support them. D. S. R.

BIBLIOGRAPHY—E. A. Burt, *Principles and Problems of Right Thinking*, 2nd ed., 1931, Chap. XVI, R. M. Eaton, *General Logic*, 1931, Part IV, Chap. 1, J. M. Keynes, *A Treatise on Probability*, 1921; and D. S. Robinson, *The Principles of Reasoning*, 2nd ed., 1930, Chap. XVIII.

PROBABILITY AND ERROR. The theory of probability is an important branch of mathematics and the basis of such applied sciences as insurance and statistical method. As an observational science becomes more highly developed, it inevitably has to deal with the problem of errors of observation, the scientific study of which requires a knowledge of the theory of probability. Probability has long been fundamental to theoretical work in astronomy, geodesy, physics, ballistics, anthropometry and actuarial science. It now holds a prominent place in research in psychology, education, biology, engineering, scientific agriculture and economics. It shows evidence of becoming increasingly important in sociology, physiology and medicine.

Traditional Definition. A definition often given is: If an event can happen in only one of a number of equally likely ways, p of which may be considered favorable and q unfavorable, then the probability that the event will turn out favorably is $p/(p+q)$. Thus the probability of exposing a four-spot on one throw of a perfectly balanced die is $\frac{1}{6}$, since there are six ways in which the die may fall, only one of which is favorable to the outcome desired. If two dice are thrown, the probability that each will show a four is $\frac{1}{36}$, since of the 36 different ways in which they can fall only one is favorable. The probability that the sum of the spots on two dice thrown together will be seven is $\frac{6}{36}$, since out of the 36 possible throws six are favorable, namely $6+1$, $5+2$, $4+3$, $3+4$, $2+5$, and $1+6$. The probability of throwing 11 with two dice is $\frac{2}{36}$, since it can be accomplished in two ways, $6+5$ or $5+6$. The probability of throwing

either 7 or 11 in one throw with two dice is $\frac{6}{36} + \frac{2}{36}$. The probability of throwing first 7 and then 11 on two successive throws is $\frac{6}{36} \times \frac{2}{36}$. For many years the only application of the theory of probability was to games of chance. The first scientific work was in a personal correspondence between the mathematicians Pascal and Fermat in 1654, relative to a gambling problem which had been proposed to the former. The matter had been suggested, however, in a printed work, Pacioli's *Sūma*, of 1494.

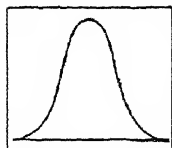
When it is possible in advance of an event to know the probability of its favorable outcome, as in most card and dice games, mathematical theory can be developed concerning the probability of certain combinations of events. Early treatises stressed this aspect of probability. The definition given above presents difficulties in the meaning of "equally likely ways," in the fact that sometimes the number of ways in which an event can happen is presumably infinite, and in the further fact that for many important situations there is no numerical value of $p/(p+q)$ which can be ascertained in advance.

Statistical Inference. The scientist who wishes to generalize for an entire population data gathered from a sample must consider questions of probability. He cannot utilize the ratio of favorable causes to total causes because this is unknown, perhaps even non-existent. His argument must be (a) from the observed frequency of the favorable outcome of an event in one sample to the probability of the occurrence of that outcome in a single future instance, or (b) from the observed frequency of the favorable outcome of an event in one sample to the probable frequency of that outcome in any other similar sample. Practical applications of probability now usually stress this aspect, which, however, did not develop historically until after compilations of data began to be available.

In 1711 a posthumous book by Jacques (Jakob, James) Bernoulli suggested that probability be applied to moral and economic questions; but no real application was made until the close of the 18th century when Laplace began writing upon astronomy and probability. His *Théorie Analytique des Probabilités* (1812) is regarded as the greatest single work on the subject. Gauss, in his astronomical researches, gave great impetus to the scientific study of errors of observation, and almost every great astronomer of the first quarter of the last century wrote at least one memoir on probability. Successful application to social problems came later and is due largely to Quetelet, who conceived of statistics as a general method of research applicable to any science of observation. With this enlargement of the field of application, there developed a new interest in the philosophical bases of probability, and what had been first only a source of perplexity to gamblers, next a challenge to the most intricate labors of the algebraists, then an essential tool in the hands of the astronomers, now became a subject of great interest for the logicians.

Sampling. Statistical inferences depend for their validity upon a knowledge of the manner in which the sample was chosen. Random, or simple, sampling implies the following: (1) The probability of being included in a particular sample must be uniform for all members of the total population. (2) The probability that a given member of the total population shall be chosen must be constant from one sample to another.

These criteria cannot be met unless the various events are independent of each other; that is, they cannot be met if the probability that a given individual shall be chosen is in any way affected by the previous choice of another individual.



NORMAL CURVE OF ERROR

Normal Curve of Error. Suppose that an astronomer, attempting to locate the position of a star, has a very large number of observations, equally reliable but differing from each other, in a purely random fashion. If he graphs these, they tend to assume the bell-shaped form known as the normal curve of

error. The equation is $y = \frac{1}{\sqrt{2\pi}} \cdot e^{-\frac{x^2}{2}}$, and the

curve is as shown in the accompanying illustration. Many kinds of data, for example measurements on the human body for an unselected group or random errors of measurement in an observational science, typically display a normal distribution. The curve is so important that many proofs for its equation have been given. De Moivre derived it in 1733, basing his proof on the binomial expansion, and having apparently no thought of possible applications. Gauss (1809) reached a similar result by setting up a differential equation of the form $dy/dx = Cxy$ and integrating it, and applied the equation in astronomy. Laplace evaluated the integral of e^{-x^2} from zero to infinity in 1778.

Probable Error. Suppose that the astronomer, who is trying to locate a point in space by means of a very large number of observations, assumes the mean of these to be the most probable value of the true position of the point. Then each of his observations differs from that mean value by what we may consider an error. If all these errors of observation are arranged in order of size without regard to sign, there will be some value such that half the errors are numerically larger and half are numerically smaller than this. The name probable error was given to this value in 1815 by the German astronomer Bessel and, misleading though the term is, it is in widespread usage to-day. In the case described, assuming the observations to form a normal distribution, the mean plus the probable error and the mean minus the probable error are two limits between which half of the observations lie, the other half being larger than the first value or smaller than the second.

When the means of a series of random samples from the same population are plotted, they usually tend to form a normal curve, each mean deviating

slightly from the mean of the entire population. Such a difference between the mean of a sample and the mean of the population may be called a sampling error. The probable error of a distribution of such means is therefore a value such that if it be added to and subtracted from the mean of the means, there will be given limits between which the means of approximately 50% of other random samples of the same population may be expected to fall. With certain specific limitations, similar statements may be made concerning not only the means but also other measures computed for a series of random samples of a population.

Least Squares. To derive the best value from a set of conflicting observations, use is commonly made of the principle that the most probable value is that for which the sum of the squares of the errors of estimate is a minimum.

H. M. W.

BIBLIOGRAPHY—I Todhunter, *History of the Mathematical Theory of Probability from Time of Pascal to that of Laplace*, 1865, Arne Fisher, *Mathematical Theory of Probabilities*, 1915, 1926, J. M. Keynes, *Treatise on Probability*, 1921, J. L. Coolidge, *Introduction to Mathematical Theory of Probability*, 1925, T. C. Fry, *Probability and Its Engineering Uses*, 1928.

PROBATE, by derivation refers to the proving of something, now it is almost entirely used in connection with wills. Until 1859 the ecclesiastical courts of England had exclusive jurisdiction, with certain exceptions, over the establishment or setting aside of wills bequeathing personal property. Trials at law were required to determine the validity of wills "devising" real estate. The fact that a will has been probated is not evidence at common law or in chancery—the will itself must be offered, and, if disputed, proved. In the United States the rules for probating wills are nearly similar to those in England; however, having no ecclesiastical courts, special courts with probate jurisdiction were set up, varying according to locality. In different jurisdictions one, two or three witnesses to the signature are required, consequently if the testator has three witnesses and a seal, the will is good in all states except where some special form of attestation is required. When a will is offered for probate it may be contested as being induced by fraud, undue influence over a weaker mind, or that the testator was incompetent to make a will from insanity, drunkenness or other cause. It can always be attacked on the ground that the statutory requirements of the locality have not been followed.

PROBLEM, a statement of something to be done. In science, it is a statement to be investigated, certain conditions being given; in geometry, one requiring the construction of a specified figure, given certain instruments and assumptions; for example, to construct a regular pentagon.

PROBLEM PLAY, a drama which has a debatable question, usually a social problem, as its basic theme. This form was originated by HENRIK IBSEN with *The League of Youth*, 1869, as a means of bringing attention to evils of his time. All except one of his subsequent plays were of this type, and include *Pil-*

lairs of Society, 1877; *A Doll's House*, 1879; *Ghosts*, 1881; *An Enemy of the People*, 1882; *The Wild Duck*, 1884; *Rosmersholm*, 1886; *The Lady from the Sea*, 1888, and *Hedda Gabler*, 1890. JOHN GALSWORTHY adopted the form for some of his most famous plays, as *Justice*, *Loyalties* and *Strife*.

PROBOSCIS, from Greek words meaning "before" and "to feed," an extravagantly elongated snout, usually of the elephant, whose proboscis is called the trunk. A true proboscis is a flexible, tubular structure, formed by the extension of the combined nose and upper lip, and containing the nostrils at the prehensile tip. Other mammalia of the group *Proboscidae* were the extinct mammoths and mastodons. The tapir has an elongated snout sometimes called a proboscis, as has the proboscis-monkey of Borneo, in which the adult male has a long, pendent nose. Certain worms and gastropods are equipped with elongated, extensible snouts or sucking mouths often called proboscides.

PROBOSCIS-FLOWER, a name often applied to the UNICORN-PLANT, a low annual bearing showy purple flowers and a large proboscis-like pod with a long curved beak.

PROCLAMATION OF 1763, an order issued by King George III on Oct. 7, 1763, forbidding the governors of the British colonies in America to grant private title to, or permit private surveys of, "all the lands and territories lying to the westward of the rivers which fall into the sea (Atlantic Ocean) from the west and northwest"; certain land warrants issued as military bounties were practically the only authorized exceptions. Sir William Johnston and John Stuart, Indian agents of the crown, were later entrusted with the demarcation of the line at which colonial settlement should halt. The intention of the crown was ultimately to create an unoccupied buffer in the interests of peace between Indians and settlers; but fur traders, frontiersmen and land speculators in America fiercely resented the restriction.

PROCRUSTES, in Greek mythology, the surname of a famous robber, Damastes or Polypemon, who lived near Eleusis in Attica. He had two beds, one long and one short, in which he invited travelers to sleep. If the visitor were short he was put in the long bed and stretched to fit, if tall he was chopped off to the length of the small bed. Procrustes was killed by his own methods by THESEUS when journeying from Troezen to Attica.

PROCTOR, in educational usage, a university official whose duties consist primarily in maintaining regulations among the students. The term is more common in England than in America. Formerly at Cambridge a proctor's jurisdiction also extended over the people of the town and was regularly exercised with respect to women of poor reputation. This function, however, was abolished in 1904.

PROCUREMENT PLANNING. See INDUSTRIAL MANAGEMENT.

PROCYON (*Alpha Canis Minoris*), a star of the first magnitude and the brightest star of the constella-

tion CANIS MINOR. Its name derives from the Greek and means forerunner of the Dog, as it rises slightly before Sirius, the Dog Star. It is among the very nearest stars, only 10 light years distant, and 5 times as luminous as the sun. It is accompanied by an exceedingly faint star, 20,000 times fainter than the sun, which revolves around Procyon in 40 years at an average distance of 1,200 million miles. See STAR: map.

PRODUCER, STAGE or MOTION PICTURE, one who stages a play or moving picture, suggesting or choosing plays, selecting casts, offering criticism at first projection or rehearsal and usually providing financial backing for the enterprise. A producer may be manager of his company or the head of several companies with managers for each. Theatrical experience, knowledge of mass psychology and exceptional business judgment and organizing ability are necessary characteristics of a successful producer.

PRODUCER GAS, one of the most important technical fuels, used extensively in the industries. Like most other gaseous fuels, producer gas is relatively clean and free from ash. Its use permits exact control of temperature and heat supply and its popularity as fuel is due to cheapness and simplicity of production.

Producer gas is formed by combustion of coal with a limited air supply. In practice, air and steam are blown through a redhot thick fuel bed. The resulting gas contains carbon monoxide, hydrogen, some carbon dioxide, and a large amount of nitrogen which is brought in by the air. The partial combustion of coal with air gives off heat and thus tends to increase the temperature of the fuel bed; the injection of steam counteracts this, as the decomposition of steam uses up heat, and therefore a control of the temperature in the gas producer is obtained by varying the amount of steam used.

The main requirement of a good grade of producer gas is low content of carbon dioxide. A disadvantage of producer gas is its low heating value due to the presence of the inert nitrogen. However, this is partly overcome by using the hot gases directly from the producer, thus making available their sensible heat. K. K.

PRODUCERS' GOODS, goods intended for use either as materials or equipment in production. In the strict economic sense they include stocks of wholesalers and retailers since economically these agents are productive because they add utility to the products they handle. Such goods bought as stocks of merchants are usually purchased on the basis of resalability. When bought as equipment or materials, they are often submitted to objective chemical or physical tests of their quality or suitability for their purpose or are bought on specification. They are often sold by their producers directly to users rather than through retail or wholesale merchants as is usually the case with CONSUMERS GOODS.

PRODUCTION, CENSUS OF, a count of the establishments of each industrial branch of a country together with the value, quantity, and quality of ar-

titles produced by each; the number of wage-earners and wages paid; and other items relevant to the particular industries. Production figures of the United States taken through regular censuses now cover manufacturing, mining, agriculture and forestry. The census figures are taken by the Bureau of Census of the Department of Commerce which was established on a permanent basis in 1902. The statistics are collected under the provisions of the census law which stipulates at what intervals they will be taken. Answers to questions sent out by the Bureau of the Census are in general compulsory and are treated confidentially. Statistics on agriculture, including irrigation and drainage, are collected by field agents, but for most of the other censuses canvassing is done by mail. The data are edited, checked, segregated and tabulated and preliminary reports are issued in mimeographed form, or as printed bulletins for each state or industry. The final and complete census reports are published from 3 to 12 months after the end of the period to which the figures pertain. Since the World War business demands for current statistics have resulted in much production data being collected and published monthly by various agencies.

PRODUCTION, COST OF. See COST OF PRODUCTION.

PRODUCTION, FACTORS OF, those things, forces, or agencies used in the production of ECONOMIC GOODS. Only those factors which are scarce and command a price need be considered in economic analysis. Traditionally these factors have been classified for the sake of simplicity into four categories: LAND, LABOR, CAPITAL and management. Some theorists regard land as merely a form of capital, occasionally management is treated as a form of labor, and the number of categories thus reduced to three or two. On the other hand, some economists regard raw materials as a category, distinct from land.

Analysis of the functions of the various factors is fundamental to an understanding of the nature of the productive process in its technological aspects, in any form of economic society, whether CAPITALISM or SOCIALISM. In a social system based on private property and contract, such analysis is essential to the search for laws or principles in accordance with which the value of the product of industry is distributed between landowners, laborers, capitalists, and ENTREPRENEURS, as land rent, WAGES, INTEREST, and PROFITS, respectively. Furthermore, the concept of factors is essential to the scientific study of the PRICE system, since the supply prices of commodities are determined by their COSTS OF PRODUCTION, and these costs are the prices which have to be paid to secure the services of the factors. The analysis may run in terms of general supply, or scarcity, and demand, or it may be refined into a consideration of marginal factors and marginal uses of factors. In either case, the proportions in which the various factors can be used to the best advantage, either from the standpoint of technological efficiency or from that of business profits, becomes of fundamental importance.

Factoral proportion is therefore a fact, and a problem, of the widest and most fundamental import, both to the economist and the business man, and most of all to the industrial engineer. Other things being equal, the technological efficiency of a given plant depends upon the efficiency with which its factoral proportions are managed. The criterion of the efficiency of management in this regard is the nearness of actual unit-cost of product to the theoretical least cost which would be reached if the plant had ideal factoral proportion and if it were running full capacity. Whenever a plant, especially one with large investment in fixed equipment, with attendant high overhead costs, operates at less than normal full capacity, its factoral proportion is out of balance, and the unit-cost of its product correspondingly high. Size of plant, however size may be defined, is also an important influence on unit-costs. Some theorists have attempted to treat size of plant as merely a special case of factoral proportion, but the two are distinct, both theoretically and practically, though not unrelated.

A. B. W.

PRODUCTION, INTERCHANGEABLE, a *mass production* method in which all parts are made so nearly alike that they can be assembled into a complete machine without alteration, and with every part having the proper amount of clearance. See TOLERANCES. Manufacturing by this method undoubtedly originated in the United States; the idea is generally credited to Eli Whitney, who first employed it in 1798 in connection with his contract for rifles for the U.S. army. Where the parts need not be extremely accurate this is easily possible, as in the making of most machinery, but where great precision is required, it is more economical to select parts to give the desired fit by actual trial.

As absolute exactness can never be secured in actual production, the permissible error, called "tolerance"—the variation from the desired dimension that can be tolerated and still have the pieces fit together satisfactorily—is generally specified. There are places where a variation of $\frac{1}{16}$ inch either way from the stated dimension may be perfectly satisfactory, in which case the tolerance would be stated as " $\frac{1}{16}$ inch plus or minus." In nearly all machine work, however, a tolerance of a few thousandths of an inch is all that can safely be allowed, and in many cases a half-thousandth or two-tenths of a thousandth of an inch is all that can be permitted. Tolerances are so specified that a shaft of a specified dimension, *plus* its tolerance, will go into a hole of a specified dimension, *less* its tolerance, and still leave room for oil, if it is a bearing. On the other hand, the smallest shaft in the largest hole, providing for the tolerance as mentioned above, must not allow too much play to be serviceable.

A tolerance of 0.001 inch plus or minus, gives a total of 0.002 inch, and when the tolerance of the mating piece is added there is a total tolerance of 0.004 inch. This plus or minus tolerance is called a bilateral tolerance, as it gives latitude on both sides

of the specified dimension. Some designers prefer unilateral tolerances in which the permissible variation is limited to one direction. In the hole, or receiving member, the tolerance is always *plus*, and in the shaft, or entering member, the tolerance is always *minus*. In other words the tolerance always calls for the removal of metal from a piece which is above or below the specified size. Both methods have their advocates and the kind of work frequently determines which one should be used.

Strict interchangeability, however, is seldom attempted where extreme accuracy is required, owing to the difficulty and cost of working to extremely close dimensions. It is a more common practice to resort to selective assembly for such parts as require extreme accuracy. These parts are carefully measured, or gaged, and assorted according to size, even though the variation between sizes is but a fraction of a thousandth of an inch. This practice is followed in assembling pistons to cylinders in even the lower priced automobiles. The cylinders are marked and the proper piston selected to give the desired clearance. There are many places where this method of selective assembly is more economical and just as satisfactory as that of strict interchangeability. The whole system of interchangeable production is constantly changing as new methods of machining and of gaging products come into use. F. H. C.

PRODUCTION CONTROL. See **INDUSTRIAL MANAGEMENT.**

PROFESSIONAL SCHOOLS, institutions of higher education which train students for the professions, including certain technical, social and commercial professions. For detailed information the following articles may be consulted: **MEDICAL EDUCATION; LEGAL EDUCATION; DENTISTRY, SCHOOLS OF; PHARMACY, SCHOOLS OF; ENGINEERING, SCHOOLS OF; AGRICULTURAL EDUCATION; JOURNALISM, SCHOOLS OF; BUSINESS ADMINISTRATION, SCHOOLS OF; NURSING EDUCATION; ARCHITECTURAL EDUCATION; TEACHERS, PREPARATION OF**

PROFIT AND LOSS STATEMENT, a statement of the operations of a business from the standpoint of its earnings or profits. It shows the progress of a business during a stated period of time, usually its fiscal period. As to content, it gives a statement of gross income, such as sales, fees, commissions and other items, and shows subtracted from this statement the cost of goods sold and the various operating expenses of the business. The difference, if gross income is the larger, is the net profit; otherwise the net loss.

BIBLIOGRAPHY.—H. G. Stockwell, *How to Read a Profit and Loss Statement.*

PROFITS, an income contingent on a concern's ability to secure a gross income larger than total expenses, including interest. Formerly political economists posited an average necessary rate of profits, a rate below which men will not stay in business. It is now generally held that no such lower limit to profits exists. Accurately speaking, the motive to

business is not profits but expectation of profits. This expectation is frequently unfulfilled. A considerable proportion of firms are always operating practically at a no-profit level, if not at a loss. Always small businesses are being set up, hanging on for a time, and then succumbing. And in a period of deep business depression even the well-established and best managed concern may fail to make expenses.

Profits are rewards for certain types of service or ability; organizing capacity, capacity to manage a business already organized, bargaining capacity and capacity both to assume and reduce risks. Profits are a composite income. Such economists emphasize organizing or managerial capacity, others risk-taking capacity, as the central function of the **ENTREPRENEUR** and the thing for which profits are the reward. In a wholly static and non-progressive state, business risks would be negligible; the only basis for profits would be managerial capacity, and its reward would probably be standardized in salaries or wages of management. Corporate **DIVIDENDS** would not greatly vary from the going rate of interest on the capital invested. No such static state exists, however. Business is full of risks. Some men delight in taking risks. Risk is the magnet which draws them into business. Others seek shelter from risks, and indeed one very significant phase of modern business is the efforts of concerns to avoid or minimize risk in every possible way. This is one of the motives to monopoly.

Profits are sometimes referred to as rent of business ability. There are certain analogies between profit and **RENT**. But profits are quite as frequently rent of differential advantages, such as priority of establishment, which have little dependence on ability.

On the whole, expectation of profits still constitutes the mainspring of business enterprise, although non-pecuniary motives, such as desire for power and prestige, play an increasing rôle. In the main, however, business still means production for profit. See also **EXCESS PROFITS TAX.** A. B. W.

PROFIT SHARING, an agreement by the terms of which an employer undertakes, in addition to paying normal wages, to share a proportion of net **PROFITS**, fixed in advance among the wage-earners of his undertaking, without involving them in losses. In the United States the first appearance of this arrangement was in 1886. Since then there have been numerous experiments with many variants of the idea, applied both to executive groups alone and to the entire rank and file. In 1931 less than 100 companies had in use a genuine profit sharing plan and practically all of these are relatively small companies with highly centralized ownership. Its introduction and continuance depend upon a disposition of the owners to share profits with the workers; successful operation continuing with reasonable permanency so that there are profits to distribute; and a plan of distribution which commends itself to all concerned as fair and favorable.

Some advocates of profit sharing have urged it as a

measure of morale-building, as helping to give the workers both an incentive and a sense of participating with the owners in sharing the prosperity of the business, as an aid to reducing LABOR TURNOVER. But it is now felt by many industrialists that other less complicated measures can more directly help to build morale; that incentives to good work must be in some more immediately enjoyable form than an annual distribution of profits; and that some form of employee stock-ownership may afford a more flexible and straight-forward method of giving workers the sense of participation in the results of good work and company prosperity. The use of profit sharing as a measure of improved industrial relations is, of course, inherently limited by virtue of the fact that in the last analysis it does depend upon a corporation's generosity which may change as corporate leadership changes due, for example, to deaths, mergers, hard times or change in public demand. And it does presuppose a healthy condition of profits which many corporations do not enjoy, especially the so-called marginal or high-cost plants in any industry.

PRO FORMA INVOICE, a list of goods which are shipped to a consignee for sale on a commission basis or forwarded on approval. It is the same as the usual type of invoice but carries the indorsement pro forma as a matter of form. Such an instrument affords the receiver of the goods complete details as to their description, quality and price. *See also* INVOICE.

PROGNOSIS, the decision that must be made in each case of illness as to the likelihood of recovery or of permanent disability in that particular condition. The prognosis includes, therefore, the possibility of sudden death. In TYPHOID FEVER early involvement of the nervous system is a bad sign. The sudden appearance of considerable numbers of germs in the blood is always a bad sign.

The prognosis may be dependent upon the occupation of the individual. Thus the prognosis for TUBERCULOSIS in a person who lives in a poverty stricken home and who works in a damp atmosphere away from the sunlight is not so good as for one who is engaged in vegetable farming or other outdoor work in the sunlight.

In DIPHTHERIA the outlook depends upon the promptness and thoroughness with which antitoxin treatment is carried out. In SCARLET FEVER, the death rates have been falling in recent years. The prognosis is usually good unless there are complications affecting the kidney, the nose, throat and ears. In PNEUMONIA the prognosis is always doubtful because of the dangers of this disease. Pneumonia in infants and in the aged is likely to have a much more severe prognosis than in those of middle age. Much depends upon proper nursing care and satisfactory treatment.

In MENINGITIS the prognosis is bad in children below the age of two. The earlier the serum is given, the better the outlook. In epidemics of INFLUENZA pregnant women suffer much more severely than other people. The young and the aged have a more un-

favorable prognosis than those of middle age. WHOOPING COUGH is a disease about which the prognosis is seldom understood. It ranks among the first of the acute infections as a cause of death in children under five years of age. In general, the prognosis is always bad in children and in people who have been much run down or "debilitated."

Certain diseases, such as pneumonic plague, have almost 100% mortality. This would apply also to CANCER not diagnosed early and removed. There are certain infections of the body, particularly attacking the joints and the heart, in which the prognosis is always bad because of the likelihood of permanent crippling of a vital organ. M. F.

PROGRAM MUSIC, a style or class of instrumental composition. It is music which endeavors, by direct imitation or by suggestion, to portray events outside the world of music proper. The title of Frederick Niecks's *History of Programme Music from the 16th Century to the Present Time* indicates the age of this endeavor; and in such latter-day compositions as Igor Stravinsky's *Fireworks* and Arthur Honegger's *Pacific 231*, the latter an attempt to portray a locomotive with an orchestral palette, modern composers are seen to be making music serve narrative ends and descriptive purposes. However, on the other side, numerous composers and critics have steadfastly allied themselves against this tendency, maintaining that the highest type of tonal expression is music without a literal subject, or what is technically known as absolute music.

According to the English critic, Ernest Newman (1868-), all vocal music, in that words are used, is program music; and if this point be admitted one is obliged to concede that many compositions which otherwise would be considered pure or absolute music actually belong to the realm of descriptive music. Moreover, such a chorus as *All We Like Sheep Have Gone Astray* in Frederick Handel's *Messiah* not only projects a descriptive text but also reinforces that text through a striking musical imitation of the helpless running to and fro of lost animals. Again, in instrumental music, Justin Knecht's *Portrait Musical de la Nature* and Ludwig van Beethoven's *Pastoral Symphony* offer examples of music which deliberately converts a symphonic orchestra into a story-telling medium, a tonal canvas. In brief, there are two opposed schools of musical thought. On the one side stand those who believe that music may legitimately describe, or attempt to describe, extraneous matters; on the other side stand those who oppose this tendency, deploring it on principle and ridiculing it on the basis of its inadequacy.

PROGRESSION, a name formerly, and now often, used for elementary finite series; for example, 2, 5, 8, 11, . . . is an arithmetic progression with a common difference 3. If a is the first term of such a series, d the common difference, l the last term, n the number of terms, and s the sum, then

$$l = a + (n - 1)d \text{ and } s = \frac{1}{2} n (a + l).$$

The series, a, ar, ar^2, \dots, l is a geometric progression. The chief formulas are

$$l = ar^{n-1}, s = (ar^n - a)/(r - 1), \text{ and } s = (l - a)/(r - 1).$$

In the repeating decimal $0.72232323 \dots$, or $0.72 + 0.0023 + 0.000023 \dots$, we see that the part after 0.72 is a geometric progression in which $a = 0.0023$, $r = 0.01$, and $n = \infty$. Hence $s = a/(1 - r) = 23/9900$, and the fraction is $0.72 + 23/9900$ or $7151/9900$. See SERIES

PROGRESSIVE PARTY, a defection from the Republican Party in 1912, organized after the Republican national convention had renominated Taft for the Presidency. The Progressives unanimously nominated THEODORE ROOSEVELT and HIRAM W. JOHNSON for the Presidency and vice-presidency on a platform calling for a wide range of reforms, including: a more expeditious method of amending the Federal Constitution; equal suffrage, regardless of sex; the public review of judicial decisions; legislation to protect employees from overwork, industrial accidents, occupational diseases, and involuntary unemployment; old age pensions; and a strong federal commission to maintain active supervision over industrial corporations engaged in interstate commerce. A very large proportion of Republican voters swelled Roosevelt's popular vote to 4,126,020 against Taft's 3,483,922. Another defection from the Republican party occurred in 1924, when an Independent Progressive Party was organized which nominated ROBERT M. LAFOLLETTE (the leader of the earlier Progressive movement until he became ill early in 1912) and BURTON K. WHEELER for the Presidency and vice-presidency, respectively. The platform assailed private monopoly, pledged radical measures for agricultural relief, advocated public ownership of railways, a Constitutional Amendment giving Congress power to reverse Supreme-Court decisions, and other reforms. LaFollette, with the support of the Socialists, polled a popular vote of 4,822,856.

PROHIBITION, in a specific sense, the legislation enacted against the manufacture and sale of alcoholic liquors for beverage consumption. Although Prohibition became a subject of universal discussion only in the 20th century, the forbidding of alcoholic liquors to entire communities is not a modern social expedient; as long ago as the 7th century Mohammed in the Koran prohibited spiritous beverages. The legal enactment of Prohibition by representatives of the people of a modern state is, however, a comparatively recent device of social welfare, and as such it originated in the United States. Community reaction against alcohol and the saloon was apparent in the North about 1840, and it led in 1846 to the enactment of State Prohibition in Maine, where the law was made more stringent in 1851, due chiefly to the labors of Neal Dow (1804-97). Prohibition candidate for the Presidency in 1880. Vermont, Rhode Island and Massachusetts passed measures in 1852 forbidding the sale of liquor. Between 1880 and 1900

the Prohibition movement gained strong support in the West and South.

The manifest difficulty of enforcement, and the unpopularity of the law in urban communities, led to a reaction against Prohibition in the first years of the present century. The state measures prohibiting the sale of alcoholic beverages were repealed in Massachusetts, Rhode Island, Iowa and the Dakotas. But the Federal Webb-Kenyon Act of 1913, barring the interstate shipment of goods held illegal in the state of destination, was of material aid to the dry cause. Shortly afterward states which had repealed their Prohibition laws reenacted similar measures, and by 1916 there were 23 dry states. At this point national Prohibition began to appear possible of enactment by Congress. As early as 1876 prohibition of spiritous liquors was proposed in the House of Representatives, but efforts to obtain Federal legislation against alcohol gathered few adherents in Congress until the United States entered the World War in 1917. On Aug. 17, 1917, the United States Senate passed a national Prohibition amendment; the House of Representatives by a vote of 282 to 128 passed a substitute measure, concurred in by the Senate on Dec. 18, 1917, providing a Constitutional amendment embracing national Prohibition, to be submitted to the states within seven years. In the spring of 1919 President Wilson called upon Congress to declare inoperative the War Prohibition Act, which had been passed by Congress on Nov. 21, 1918. . . . the sale of liquor, except for export, . . . and of demobilization. Congress declined to repeal the emergency measure, and on Oct. 28, 1919, enacted the Volstead Prohibition Enforcement Act over his veto. This measure defined intoxicating liquor as liquor containing more than one-half of 1% alcohol. Forty-six states had ratified the national Prohibition Amendment by Jan. 29, 1919, and as the 18th Amendment it was accordingly declared in effect on Jan. 16, 1920. The amendment, and the definition of intoxicating liquor in the Volstead Act, were sustained by the United States Supreme Court on June 7, 1920, and the amendment was again declared valid on Feb. 24, 1931, in a decision reversing a ruling by United States District Judge William Clark of New Jersey that the amendment was unconstitutional in light of the 5th Article of the Constitution.

While the enactment of national Prohibition was a signal victory for the antisaloon movement, the mere fact of enactment did not bring to an end the manufacture, sale and consumption of alcoholic beverages. The task of policing a nation of more than 100,000,000 people, with a land boundary of 5,875 miles and an ocean, lake and river boundary of 10,785 miles, has proved one of great difficulty.

The National ("Wickersham") Commission on Law Enforcement and Observance, in its final report on Prohibition delivered to the President on Jan. 20, 1931, disclosed itself as standing seven to four against the form of the 18th Amendment, five of the seven favoring revision and two seeking repeal.

Prohibition Abroad. National Prohibition was adopted in 1912 in Iceland, where manufacture of alcoholic beverages was forbidden in 1899; the interdiction was later modified to permit the consumption of foreign wines. Norway enacted national legislation against spirits and heavy wines in 1921, repealing the measure in 1926. Prohibition was adopted by Finland in 1919, and repealed by popular referendum in Sept. 1931.

G. E. G. C.

BIBLIOGRAPHY.—I. Fisher and H. Broughan, *A Noble Experiment*, 1930; G. E. G. Catlin, *Liquor Control*, 1931.

PROHIBITION PARTY. Having attempted unsuccessfully to induce either of the major national parties to endorse their reform movement, the advocates of prohibition in 1869 organized the National Prohibition party. Its first national convention, at Columbus, O., Feb. 22, 1872, nominated candidates for president and vice-president; and in all subsequent national elections the party has entered candidates. Its largest presidential vote, 271,000, was polled in 1892 for John Bidwell of California. Against the opposition of the Anti-Saloon League the party has continued in existence since the adoption of the 18th amendment, asserting in its platform of 1928 that "the present unsatisfactory enforcement of prohibition, amounting to nullification over wide areas," is the result of the tendency of friends of prohibition to vote for one of the major parties, "both dependent for success upon the votes of their wet members."

PROJECTIVE GEOMETRY. Before considering this subject, it is necessary to understand what is meant by projection. We shall first take a simple illustration from our experience in daily life and then discuss the subject briefly from the mathematical standpoint. If a point P is propelled or thrown out along a straight line l from a fixed point O , we say that P is projected from the center O . (Fig. 1.)

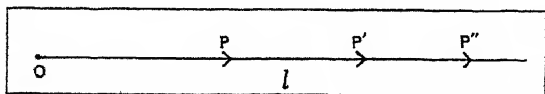


FIG. 1

The projection of pictures from a plate or a film on to a screen furnishes one of the simplest illustrations of projections in daily life. In this case the light is the center of projection and every point on the plate or film is thrown in a straight line on to the screen.

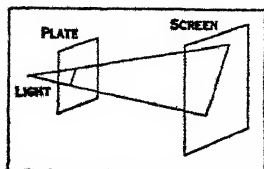


FIG. 2

We speak of the light as the center of projection, the rays as the projecting lines, and the screen as a section of the projecting rays. The screen projection of pictures is a special case of projective geometry where the shape of figures is retained, while the size is changed from a small figure on the plate or film to a figure of normal size on the screen. In general, projection changes both the size

and the shape of a figure, as is illustrated by Fig. 3, where the circle is projected into an ellipse.

Since a fundamental postulate of EUCLIDEAN GEOMETRY is that a figure may be moved about freely in space without changing its size or shape, the magnitude of figures quite naturally becomes a topic for general consideration. For example, the proposition that the opposite sides of a parallelogram are equal refers to measurement. Practically all the propositions and exercises of elementary geometry are concerned with the magnitude of line segments, angles, areas and volumes, these relating to various plane and space figures. In projective geometry, on the other hand, very few of the propositions refer to measurement. There are certain properties of figures, called projective properties, that are not changed under projection, and it is the investigation of these properties which forms the subject of *projective geometry*.

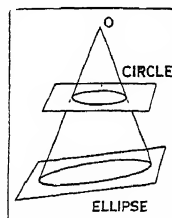


FIG. 3

Fundamental Operations. The two fundamental operations of projective geometry are projection and section. In the plane, projection can be made from a point S , called the center of projection, as in Fig. 4. In Fig. 4 each of the points on the line l , called a

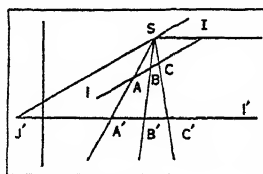


FIG. 4

range of points, such as A, B, C, \dots , is carried into its corresponding point A', B', C', \dots on l' , the projecting ray such as SA being formed by joining each point on l to the center S . The totality of lines through the center S is called a flat pencil of lines, and any line such as l' cutting the pencil is said to be a section of the pencil. It is at once evident that the length of the segment AB which is projected into the segment $A'B'$ is changed by the projection.

Infinite Point. It is also evident that each point of l , with the exception of I , where the ray SI is parallel to l' , has a corresponding point on l' . Since there is no corresponding point on l' to match I , we endow l' with a point called the ideal point or the infinite point which is to correspond to I . Similarly l is given an infinite point to correspond to J' . Thus in projective geometry a straight line has one and only one infinite point. A similar argument with reference to planes shows the necessity of endowing the plane with one and only one infinite straight line. With an infinite point added to each line, there exists a perfect one to one correspondence in projective geometry between the points of l and l' . By this we mean that to every point on l , there corresponds under projection one and only one point on l' , and conversely. Similarly in three dimensional space, if two planes are projectively related, there is a one to one correspondence existing between the points of one and the points of the other (Fig. 6). The lines of one plane

also have a one to one correspondence with the lines of the other.

In three dimensional space, a projection can be

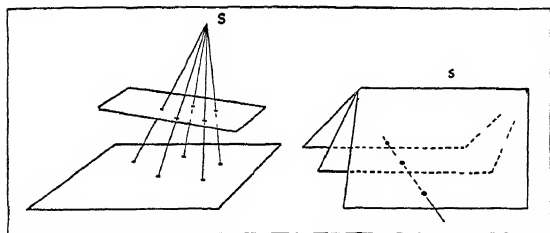


FIG. 5

FIG. 6

made from a center S as in Fig. 5 or from a line s called the axis, as in Fig. 6.

Anharmonic Ratio. One of the important theorems which is proved in projective geometry is that if four points on a line l such as A, B, C, D are projected into four other points A', B', C', D' on l' , as in Fig. 7,

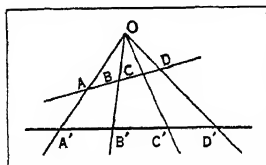


FIG. 7

the ratio of the two simple ratios $\frac{AC}{BC} : \frac{AD}{BD}$ for the

first line is equal to $\frac{A'C'}{B'C'} : \frac{A'D'}{B'D'}$ for the second line.

$$\text{That is } \frac{\frac{AC}{BC}}{\frac{AD}{BD}} = \frac{\frac{A'C'}{B'C'}}{\frac{A'D'}{B'D'}}$$

This ratio of the two ratios is often called the double ratio, or the cross ratio, or the anharmonic ratio of the four points. The ANHARMONIC RATIO, which remains unchanged under projection, is the fundamental invariant of projective geometry.

It should be noted that when we speak of a figure in projective geometry, we mean the totality of points, lines and planes that the figure contains. For example, the complete quadrangle is determined primarily by any four points, such as A, B, C and D in Fig. 8. These four points in turn determine the six lines shown in the figure. The six lines are called sides of the complete quadrangle and they in turn determine the three points E, F and G called diagonal points. The entire configuration of lines and points is called a complete quadrangle.

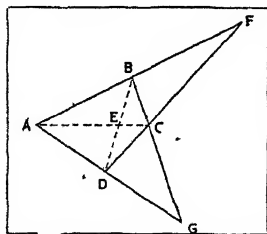


FIG. 8

The following illustrations will give some idea of the concept of duality which is an important aspect of projective geometry. A line or a range of points may be thought of as generated by a moving point, taking the successive positions of each point on the line (Fig. 9).

Thus the line consists of the aggregate of elements, or points, on it. Similarly, the point O (Fig. 10) may be thought of as the aggregate of elements, or lines passing through the point. Thus in Fig. 10, if the line p

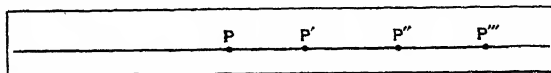


FIG. 9

moves so as to take the successive positions p, p', p'', p''', \dots , the point O contains, or lies on, each element of the aggregate. Thus the range of points and the flat pencil of lines are said to be dual configurations.

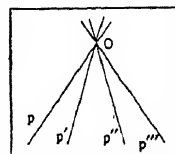


FIG. 10

The two statements "Two points determine a line" and "Two lines determine a point" are dual statements in plane projective geometry. In the plane a theorem may be changed into its dual theorem by interchanging the words "point" and "line." Under duality figures and also their projective properties co-exist in pairs. The dual elements in three dimensional space are the "point" and the "plane," the "line" being dual to itself. From the many important and elegant theorems of projective geometry, we shall give only two as typical of the subject.

Pascal's Theorem ($q.v.$; proved in 1640): If a hexagon $AB'CA'BC'$ is inscribed in a conic, the three

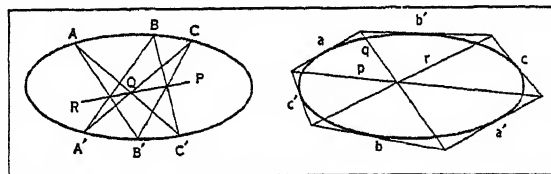


FIG. 11

FIG. 12

pairs of opposite sides intersect one another in three collinear points P, Q, R . (Fig. 11.)

BRIANCHON'S THEOREM, dual of Pascal's Theorem and proved in 1806: If a hexagon $ab'ca'bc'$ is circumscribed about a conic, the straight lines p, q , and r which join the three pairs of opposite vertices meet in a point. (Fig. 12.)

G. W. M.

BIBLIOGRAPHY.—The following books offer a simple introduction to the subject Lehmer, *Projective Geometry*, 1917; Ling, Wentworth, Smith, *Projective Geometry*, 1922. For a more advanced text, consult Veblen and Young, *Projective Geometry*, 1910; Graustein, *Introduction to Higher Geometry*, 1930.

PROLETARIAT, a word derived from the Latin *proletarius* (*proles*, offspring), a name given to a member of the lowest class in ancient Rome, since he was possessed of no property and was, therefore, regarded as being able to serve the state chiefly by having children. In modern usage the term has taken on a new significance from the doctrines of class struggle of Marxian Socialism. Proletariat is now used to mean the great body of workers dependent on their wages for a daily living, as distinct from the capitalists

and from the middle class. The communist state in Russia calls itself "a dictatorship of the proletariat."

PROLOGUE AND EPILOGUE. The function of prologue in the drama is one of orientation to the play; that of epilogue is one of reorientation to external life.

The prologue is foreshadowed in the Æschylean tragedies (see *ÆSCHYLUS*). The burden of expository material being great, long introductory recitations are assigned to characters in the play, to the chorus, or to characters used for that purpose only (the pythoness in the *Eumenides*, and "Might" and "Force" in the *Prometheus Bound*). The Sophoclean dramas, remarkable for their self-contained modernity, dispense with the device almost entirely. In the hands of EURIPIDES, however, the prologue, often placed in the mouth of a deity, is developed into the equivalent of a first act, and is so elaborately and integrally knitted into the play by choral hymns that ARISTOTLE, defining it as "the whole part of the tragedy, prior to the entrance of the chorus," includes it as one of his four quantitatively requisite parts.

Mood was dominant in the use made of the prologue in the early mystery and morality plays (see *MYSTERY PLAYS*; *MORALITIES*). In the former, the passing over of a religious service into a liturgical play made highly appropriate the exhortations which came between, and which attached themselves permanently to the representational parts of the ritual, in the latter, the definitely religious or ethical contents of works intended for production in the public squares called for introductory movements in like character.

As the influence of churchly tradition relaxed, the drama became freer. The prologue, while frequently used by Elizabethan dramatists, ceased to be indispensable; it is only exceptionally to be found in Shakespeare. It was with the coming of the RESTORATION DRAMA, and the arrival of French classicism, that the prologue reached its heyday. A greater mastery of playwrighting technique had relieved dramatists of the necessity of prefixing accessory first acts; but the prologue could be, and occasionally was employed for political or controversial purposes. CONGREVE did not hesitate to use the prologue to *Love for Love*, 1695, to attack a rival manager who had attempted to hire away his actors.

The formal prologue is rare in modern writing, its place being taken by the exposition (see *PLAYWRIGHTING*) which occurs early in the play. It may be a single set speech, establishing tonality, as in the famous prologue to Leoncavallo's opera, *I Pagliacci*, or in the sonnets prefixed to the first and second acts of Shakespeare's *Romeo and Juliet*. It may be a brief scene creating atmosphere and containing exposition, as in G. B. Shaw's *Androcles and the Lion*, or a chain of scenes merging into the play, as in the overwhelmingly powerful witch episodes which open Shakespeare's *Macbeth*. When the time interval is large, and particularly when the "play within a play" construction is adopted, the prologue is necessarily more elaborate, occupying an act or the major part of one.

In Edward Sheldon's *Romance*, Beulah Marie Dix and Evelyn Greenleaf Sutherland's *The Road to Yesterday*, and Elmer Rice's *On Trial*, prologues establish the time and the problems of to-day. The interior actions "flash back" many years, and are recoordinated with the present through brief epilogues. In G. B. Shaw's *Fanny's First Play*, an "induction" and an epilogue, both ultra-conservative in thought, are used to bracket a radical inner play, supposedly written by an "advanced" young woman.

While the Greek tragedies, particularly those of Æschylus, terminated in noble choral hymns, whose function was to quiet the emotions so recently played on, the formal epilogue did not exist and was not recognized as such in GREEK DRAMA.

From the single work *Plaudite*, invariably appended to the Roman plays, arose a rhymed speech dedicated partly to the formulation of a moral and partly to praise of the play. Owing its later vogue to BEN JONSON, it came to be taken so seriously that JOHN DRYDEN in 1672 published his *Defence of the Epilogue* in its support, and no piece of the Restoration period was considered complete without it.

From a technical standpoint, the epilogue, in the form in which it flourished during the 17th and 18th centuries, is a dramatic excrescence, subserving no useful function, while tending strongly to destroy an artistic objectivity. Its formulation of a moral is psychologically and dramaturgically unsound: if the thought of a play is not clear when the final curtain has fallen, the addition of an epilogue can make clear only the dramatist's confession of failure. The modern epilogue, which is uncommon, has a reason for being only when an exceptional construction makes it a structurally necessary part of the play. P. W.

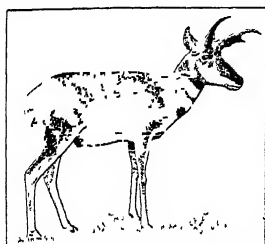
PROMETHEA MOTH, one of the commonest species (*Callosamia promethea*) of the giant silkworms. Males are almost black and diurnal. Females are light reddish brown. Mature larvæ are bluish green, and bear rows of tubercles the length of the body. They feed on many kinds of trees, especially lilac and wild cherry. Cocoon is elongated and wrapped in a leaf, which is securely fastened to the branch by bands of silk.

PROMETHEUS, in Greek mythology, son of the Titan Iapetus, brother of EPIMETHEUS, and father of DEUCALION. He warned his brother against receiving PANDORA and incurred the anger of Zeus by stealing fire from heaven for man. The god punished him by chaining him to a rock where a vulture daily devoured his liver which grew again at night. Prometheus could be freed only by an immortal renouncing immortality for him. This was done by CHEIRON who had been shot by one of Hercules's poisoned arrows.

PROMINENCE, in astronomy, the crimson colored flames of hydrogen extending high above the sun's atmosphere and visible to the unaided eye during a total eclipse. See SUN.

PROMISSORY NOTE. See BILL OF EXCHANGE; COMMERCIAL PAPER.

PRONGHORN (*Antilocapra americana*), an antelope-like mammal inhabiting open plains in western North America, called also prongbuck. It is about the size of a fallow deer, standing 3 ft. high at the shoulder. In color it is chestnut with a white patch on the rump, three white bars at the throat and white underparts and buttocks. On the buttocks there are long white hairs which can be erected and expanded



PRONGHORN

into bunches, serving as guides to the herd when danger approaches and when in flight. The mane is thick, the tail short, and the ears long and pointed. The pronghorn is the only existing representative of a family intermediate in some respects between deer and cattle. They are not typical of the hollow-horned ruminants because their horns are branched and are annually shed and renewed. The compressed scimitar-like horns are black and rise vertically about the eyes. The prongbuck has no lateral hoofs. Sometimes the female prongbucks are completely hornless although they usually have rudimentary horns. They produce one or two young at a birth. Although formerly abundant the pronghorn is in danger of extinction.

PROOFREADING, the careful reading, with the aid of the original manuscript, of Proofs taken of type to be used for printing. Otherwise acceptable printing may be rendered wholly unsatisfactory by glaring typographical errors; hence, the skilled readers to make careful check before printing are important. A reader usually works in company with a copyholder, who reads aloud the manuscript as the reader follows on the proof. Thorough familiarity with all details of literary and typographical style is an essential qualification, and a wide knowledge of historical, scientific and literary facts is helpful.

In book work, galley proofs usually get a first reading with the manuscript, and a revision after each correction. A silent reading follows paging, and still another after the pages are locked up for plating. Invariably, corrections are revised. In special cases proofs of the plates are read also. Authors are furnished proofs of both galleys and pages. Corrections that deviate from the manuscript are usually chargeable as author's alterations. E. W. P.

PROOFS, any print of a type mass or plate for a temporary purpose. It serves as a means of checking the accuracy of composition work. In book composition the first proofs are made on long sheets of paper, called galleys, and are proofs of type as run off from a type-setting machine or set (as formerly) by hand, and stored on long, narrow trays. The second set of proofs are page proofs and are made after the galley proofs are returned with corrections. These corrections having been made, the galleys of type are released for "makeup." In this process the type in the galleys is split up into pages of equal length, chapters

beginning on new pages. The page proofs may be made on long sheets, as in the galleys, but with the individual pages separated by a space, or the pages may be proved up singly on small sheets of paper, or two or more on a sheet. When the pages are returned for "casting," the type is locked up with four or eight or sixteen pages to a form, and proofs made of these forms, which will show the lockup rules as black borders on all sides of pages. These are called foundry proofs, and are the last to be shown before the pages are electrotyped into plates.

PROOF SPIRIT, an alcoholic liquor taken as the standard for all spirits. This standard consists, in the United States, of a mixture of alcohol and water, half of the volume being alcohol which at 60° F has a specific gravity of .7939. At 60° F., proof spirit has a specific gravity of .93353. The designation of alcoholic strength as 50 proof or 100 proof may be expressed in percentages of alcohol in the mixture on the basis of 200 proof as 100% alcohol. Thus 50 proof mixture means 25% alcohol; 100 proof is 50% alcohol.

PROPAGANDA, the management of collective attitudes by means of significant symbols, rather than by violence, passive resistance, non-cooperation, bribery and allied methods of social control. Propaganda differs from education in that it is unconcerned with the inculcation of techniques of doing and thinking. The problem of the propagandist is to present a person, group, institution or course of action in such a way that the desired responses will be forthcoming. The propagandist must intensify the attitudes of those who are favorable to his purpose, reverse the attitudes of those who are hostile and attract the indifferent, or at the worst, prevent them from becoming hostile. The propagandist must possess an intimate knowledge of the culture in which he is operating.

Symbols which are significant to a group may be embodied in spoken, written, pictorial or musical form and the number of stimulus carriers is infinite. Thus people who ride in street cars may be reached by placards posted inside the car, by posters on the billboards along the track, by newspapers which they read, by conversations which they overhear, by leaflets which are openly or surreptitiously slipped into their hands, by street demonstrations at halting places and by numerous other means.

Propaganda rose to transitory importance in the past whenever a social system based upon the sanctions of antiquity was broken up by a tyrant. Since control areas do not coincide with activity areas, propagandas operate across local and national boundaries. A new division of labor has arisen to manipulate opinion. The advertiser who bought publicity has been followed by the public relations counsel who makes interesting news. Propagandists often modify the policy of the institutions with which they are associated in the hope of reducing or preventing friction. Efforts to control propaganda involve censorship, public hearings and the incorporation of functional groups in government. H. D. L.

PROPAGATION OF LIGHT. See LIGHT.

PROPANE, the third member of the paraffin series (see PARAFFIN COMPOUNDS) of HYDROCARBONS. Propane has the chemical formula C_3H_8 . It is a gas under ordinary conditions, melting at $-189.9^\circ C$; normal boiling point $-42.2^\circ C$, but may be liquefied under pressure up to $95.6^\circ C$. The specific gravity of the liquid is 0.5091. Propane is a component of NATURAL GAS and is produced commercially as a by-product of the rectification of GASOLINE recovered from natural gas. It is distributed commercially as a liquid in pressure cylinders for use as a fuel for welding and other purposes requiring a portable fuel supply, for gas enrichment, and for household purposes where city gas distribution is not available. See also GASES, LIQUEFIED.

BIBLIOGRAPHY—Dana, Jenkins, Burdick and Timm, *Refrigeration Engineering*, p 387, 1925-26, B. T. Brooks, *Chemistry of the Non-Benzenoid Hydrocarbon*, 1922

PROPANOL, the modern scientific name for the two isomeric substances formerly known as propyl alcohol. They may be considered as derived from the saturated hydrocarbon propane, C_3H_8 , by replacing one of its hydrogen atoms by a hydroxyl-group. If this substitution takes place at the end of the chain, normal propanol, $CH_3 \cdot CH_2 \cdot CH_2OH$, results; if in the middle, iso-propanol, $CH_3 \cdot CHOH \cdot CH_3$. Both are colorless liquids with a pleasant aroma, the latter is of more importance industrially, since it is used as a solvent for alkaloids. It is prepared commercially by first "cracking" petroleum-oil to obtain propylene, which, upon further treatment with sulphuric acid and water, yields iso-propanol.

PROPELLER or **WHEEL** as installed on a vessel is a device of screw form fastened to shafting from the engine, for propelling the vessel. Propellers are either cast in one piece, i.e., solid of iron or manganese bronze, or they may be "built up," that is, have a cast iron hub to which are bolted manganese bronze blades. Small propellers for motorboats are invariably cast solid, and it is the present practice to install solid wheels on large passenger vessels.

The pitch of a propeller is the longitudinal distance, it would travel at one revolution, were it to revolve in an unyielding medium as in a fixed nut. The diameter is the diameter of the circle swept by the tips of the blades. Pitch ratio is the pitch divided by the diameter.

The number of blades depends on the type of vessel and revolutions of engine. For small motor boats, two blades, for tug boats, four blades with broad tips, cargo vessels four blades, while for high speed Atlantic liners, some have been fitted with three bladed wheels and others with four.

In designing a propeller, many factors have to be considered, as the lines of the vessel particularly her after body, the revolutions of the engine and the speed the vessel is to make. For aircraft propeller see AIR PROPELLER.

BIBLIOGRAPHY.—C. W. Dyson, *Screw Propeller and Estimation of Power for Propulsion of Ships*; D. W. Taylor, *Speed and Power of Ships*.

PROPELLER THEORY. In order to investigate the theory of propeller action in detail, the simple-blade element theory of Drzewiecki may be used. Here the propeller blades are considered as an infinite number of small AIRFOIL or wing section elements, and the air forces on each may be calculated from recorded WIND TUNNEL test data of airfoil characteristics. The air flow around each element is considered two-dimensional and is, therefore, unaffected by the parts of the blade adjacent to it. The blade element theory deals primarily with the forces acting on the propeller blades. See also AIR PROPELLER; AIR PROPELLER STRESSES.

PROPER MOTION, the apparent motion of a star in the sky with reference to other stars, which is due to its own motion in space. Proper motions are found by comparing accurate positions of stars determined at different times, and are expressed in terms of seconds of arc per year. The largest known motion is that of BARNARD'S STAR, amounting to $10''.25$ per year or to one degree in 352 years. It is clear that for the same linear speed the angular apparent motion in the sky is smaller for distant stars than for near-by stars, and that for very distant stars, however large their speed in miles per second, the proper motion is inappreciable.

The sun, being a star, has its own motion in space, carrying the earth with it. Thus part of the proper motions of the stars must be due to a mere reflex of this solar motion. This part is called the parallactic motion, while the remainder, inherent in the stars themselves, is called peculiar motion.

A star at a distance of 100 light years, and still to be reckoned among the nearer stars, with a speed of 20 miles a second across the line of sight, not far from the average for the stars, would show a proper motion of only $0''.2$ and would take 17,000 years to move one degree. The result of the motions of the stars observed in the sky is very small, therefore, and although ultimately all constellations will be altered, the change visible to the naked eye in 100,000 years would not be very large.

W. J. L.

PROPERTIUS, SEXTUS AURELIUS (c. 50-c. 15 B.C.), Roman elegiac poet, was born at Asisium, now Assisi, in Umbria, about 50 B.C. He came of wealthy parents, but had some of his property confiscated after the battle of Philippi. He then moved to Rome and studied law, and made many friends among distinguished men, including Ovid and MAECENAS. His love poems are his best, the first of which, called *Cynthia*, was in honor of his mistress who seems to have had great influence over him; his other elegies, chiefly on political and historical themes, are less notable. It is thought that Propertius died about 15 B.C., probably in Rome. See also ELEGY; LATIN LITERATURE.

PROPERTY, PRIMITIVE. See PRIMITIVE PROPERTY.

PROPERTY LAW protects the social interests centering in what the law recognizes as a man's belongings.

Title is the right to hold, use, and regain property; it includes the privileges of user, destruction, or sale, and the rights to be protected therein. Save in very exceptional proceedings our law never establishes title as against all the world but merely declares the better right to possession as between actual litigants; and only they and their privies are bound by the decision. Title is usually derivative, from a former owner; but it may be original, gained by occupancy, ADVERSE POSSESSION, or adverse user. Any property may be owned by several persons under some form of co-ownership. Also, title to land and, in various states, to relatively imperishable chattels may be split into a series of interests held simultaneously by different persons, one only having an estate in possession, the others holding present interests of successive future enjoyment; some of which expectancies may be destructible or may otherwise fail.

No such thing as absolute individual property exists. Society controls the use of land, to protect neighbors or the public, by INJUNCTIONS or by police power; and, rarely, the use of CHATTELS. The acquisition of original title, likewise the mode of transferring title—during life by gifts, sales, or conveyances, or upon death by will—is also controlled. Physical control plus some assertive animus is essential to acquisition of original title; but in gifts, sales, and conveyancing the requirement of actual transfer of control has been greatly weakened. Modern theories of social reform have greatly weakened the individualistic philosophy of the old property law. Transfer and inheritance taxation and governmental control of business illustrate the present tendency.

Property falls under the heads of REAL PROPERTY, PERSONAL PROPERTY, and leaseholds (see LEASE) for years. The rules governing contracts for, and conveyances, mortgages, inheritance, and wills of realty and personality, respectively, differ exceedingly. The law of leaseholds is also distinct. F. S. P.

PROPERTY RIGHTS. As interpreted by primitive peoples, property rights differ from those of complex societies but are definite and not necessarily communistic as was once supposed. Land belongs to the tribe (in Africa to the king), and though certain families may always have used particular garden plots or hunting grounds, they would have no right to sell or transfer them. Food, which may mean the difference between life and death, is always shared. Sometimes a whole community joins in hunting, fishing or gardening and divides the product. When these enterprises are conducted by individuals, gifts are generally made by the individuals to their neighbors. Often a rigid law of hospitality demands that any one who enters a man's dwelling must receive food, no matter how little food there may be. Clothes and tools, on the other hand, are definitely the property of the person who wears or uses them, and manufactured products, such as pots and baskets, belong to the one who makes them.

PROPERTY TAX, GENERAL, a tax on property in general, that is, on all property not expressly

exempted from TAXATION. Since property is regarded as a homogeneous mass under this tax, it is all to be taxed at the same rate within any taxing district. The tax is often referred to as the uniform rule of taxation, from this use of a single uniform rate in each tax district and the lack of any distinction or differentiation of rates on different classes of property.

The general property tax usually appears in primitive and economically undeveloped communities. It was known in Roman times, in medieval England, and in the American Colonies. Unfortunately, it was embedded in many of the state constitutions during the 19th century, and in some cases it has proved impossible to secure a change, even to the present, because of the inability of different sections and group interests to agree on a reform program.

The theory underlying the general property tax apparently is that property as such, without differentiation or classification, is a proper and sufficient measure of taxable capacity. Those who possess property should all be taxed thereon at a uniform rate; those who do not own property have no capacity to pay taxes. This assumption may be sufficiently near the truth in an undeveloped community, especially if land be abundant, but it fails completely in a modern complicated economic and social order.

Under modern conditions, property is not simply a mass of tangible, physical wealth, any part of which denotes substantially the same level of tax obligation as any other. The rise of the business corporation and of the modern banking structure (see BANKS AND BANKING) have brought forth many legal forms of property which have value because they represent various types of right over and interest in the control of and the income from tangible wealth. This general class is known as intangible property, and the most conspicuous examples are corporation Stocks and BONDS. However important these forms of intangible property may be to the owners, the great bulk of them simply represent the respective owners' interests in the physical ASSETS which support them and determine their value. If these assets are taxed to the corporation, the taxation of the stocks and bonds to the several owners would clearly be double taxation. It would be counting the same things twice. It is equivalent to adding together the corporate assets and the corporate liabilities to determine the total value of the corporate property for tax purposes.

Many states have recognized this fact to the extent of exempting the stocks of domestic corporations. This act evidently assumes that all domestic corporations are taxed on all of their property by the state giving the exemption, and that no foreign corporations are taxed on property by such state. Moreover, the limitation of the exemption to stocks ignores entirely the position of bonds or other credit instruments as representative wealth.

The assumption that property in general is a sufficient yardstick with which to measure all tax obligation is also faulty today. There are many persons who own little or no property, but who receive sub-

stantial incomes from personal services. INCOME TAX returns indicate that less than half of the income reported is derived from property. This means that property is no longer an adequate measure of taxable capacity or obligation.

On account of the ease with which the owners of intangible property could evade the tax, the attempt to tax all property, including intangibles, at a uniform rate in each taxing district developed practical difficulties as soon as the amount of intangibles became important. Evasion was accomplished by moving to more lenient states, by establishing tax colonies at the seashore or elsewhere, by investing in such securities as were legally tax-exempt or by committing perjury in making the tax return. The assessor was helpless against most of these practices, the total effect of which was to cause a steady shrinkage in the proportions, and even in the aggregate of intangible property assessed for taxation. The general property tax became, in practice, a tax on real and tangible personal property, and on a very small proportion of the entire amount of taxable intangible property.

As the mass of wealth increased, and as tax rates rose to meet the growing public expenditure, other aspects of general property tax administration also gave trouble. Every state originally had small assessment districts, and the assessor, usually locally elected, frequently had inadequate technical qualifications for the task. Undervaluation, particularly of large properties, became increasingly frequent, thereby causing further inflation of the rates of tax levy. The taxpayer who received a low assessment escaped some part of his fair share of all property taxes; the district which had a low aggregate assessment thereby escaped some part of its proper quota of county or state taxes.

This tendency was first met by the creation of county and state boards of equalization, the duty of which was to review and equalize assessments. Their limited powers, and even more limited conception of the real nature of the problem, resulted in little more than certain arbitrary changes, often inspired by political exigencies. Another step taken to improve assessment conditions was the transfer of public utility properties to state boards of assessment. The breakdown of local assessment of large property units was first apparent in the case of railroad and other utility corporations.

The last step in the administrative improvement was the creation of state tax commissions, which often absorbed the functions of equalization and utility assessment. Their significant new function was the supervision of local assessors. Some of these tax commissions have had broad powers of supervision, but none of them have been able to preserve the general property tax against decay at its most critical point, which is the enforcement of the uniform rule for the assessment of intangibles. The state tax commission has proved its worth as an administrative improvement, and it has become the center of control for such taxes as have been introduced to replace the obsolete general property tax.

The reform of property taxation, once the inadequacy and inequity of the uniform rule has been recognized, has taken different directions. There has been no uniformity of procedure in this reform since each state has been inclined to introduce such taxes as were approved by local sentiment, itself a reflection of the local self-interest. In some states the emphasis has been upon some kind of property classification, which may be limited to a recognition of the distinction between tangible and intangible property, or which may be extended to a detailed, though usually arbitrary and artificial division of all forms of property into classes. The chief advantage of classification can be realized, and much administrative friction avoided, if the scheme goes no further than the recognition of intangibles as a class requiring separate treatment.

In other states, the emphasis has been placed upon income taxes, under which the income from intangibles has been taxed in lieu of the former attempts to tax them as property. Either of these alternatives will afford a reasonably satisfactory solution of the central theoretical and practical difficulty of the general property tax, which is the proper treatment of intangible property. H. L. L.

BIBLIOGRAPHY—H. L. Lutz, *Public Finance*, S. E. Leland, *The Classified Property Tax in the United States*; E. R. Seligman, *Essays in Taxation*.

PROPHÈTE, LE, on opera in five acts by GIACOMO MEYERBEER, libretto by EUGÈNE SCRIBE; première, Paris, and London, 1849, New Orleans, 1850, New York, 1853. Succeeding *Les Huguenots* and preceding *L'Africaine* it shares with both the distinction of belonging to the trio of the composer's most famous operas.

An innkeeper of Leyden, by name John, is in love with Bertha whose liege lord, the Count of Oberthal, has designs upon her and therefore withholds his assent to the marriage. Escaping from the count she flies to John for protection, whereupon Fidès, his mother, is seized by the count and threatened with death unless Bertha is promptly returned to him. Outraged, John proceeds to join the Anabaptists, a religious sect sworn to combat the sin and fraud perpetrated by the powerful nobles. The Anabaptists, seeing in John their expected prophet, proclaim him the son of God, seize the city of Munster, and install the former innkeeper as their holy leader. During the ceremonies Fidès rushes forward to embrace her son whom she believed killed by one of the false prophets; but he, unable to jeopardize his celestial rank by admitting terrestrial connections, repudiates his mother and compels her to acknowledge her error. Fidès is punished with imprisonment. John later visits the old woman and craves her pardon, but as he discovers a plot against himself, hatched by some revolted Anabaptists, he shortly ends the revolt and his own life by blowing up the palace of Munster.

PROPHETS, inspired ancient Hebrews who fearlessly denounced oppression, corruption, violence and injustice during the days of the kings of Israel and Judah, and upheld the laws of humanity, righteous-

ness, justice and moral integrity. Those prophets who left no literary remains or writings are called the early or non-literary prophets. The most important of these were Samuel, Ahiyah of Shiloh, Micaiah ben Imlah, Nathan, Gad, Elijah and Elisha. Those prophets who wrote, or had written for them by others, prophetic books of guidance, moral instruction, national and political counsel, and doctrines concerning the proper relations to be observed among human beings, are called the literary prophets. They were Isaiah; Deutero-Isaiah, the second Isaiah, whose own name is unknown; Trito-Isaiah, the third Isaiah, whose name, too, is unknown; Jeremiah; Ezekiel; Hosea; Joel; Amos; Obadiah; Micah; Nahum; Habakkuk; Zephaniah; Haggai; Zechariah, and Malachi.

Early Prophets. Prophecy and prophets appeared early in ancient Hebrew history. Gad and Nathan appeared during the reign of David, about 1000-977 B.C. Samuel ministered as priest and prophet in the early days of the kingdom under Saul, immediately preceding the reign of David. Elijah and Micaiah ben Imlah prophesied under Ahab, King of Israel about 750 B.C., and Elisha under Jehu, several decades later, immediately following Elijah, whose disciple and successor he was. The earlier prophets partook more of the nature of seers, wonder-workers, announcers of the word of God, finders of lost objects. Like Elisha, they were credited with being able to perform miracles, and even engaged in contests with the Canaanite god Baal, as did Elijah, or had bands of disciples who were subjected to ecstatic fits, like Elisha and Samuel, or could find lost objects and restore them to their owners, as did Samuel. In the early days of prophecy, from Samuel through Elisha, there were thousands of *bene nebiim*, or members of the prophetic schools, who traversed the country and infected others with their artificial enthusiasm, or who struggled in behalf of the pure worship of Yahweh. (Cf. I Samuel 9-10; I Kings 18; II Kings 1-10.) Such prophets, or disciples of prophets, played an important part in rousing the Hebrew people to the struggle for their independence and very existence against the Philistines in the days of Samuel, and to the struggle against Baal worship in the days of Elijah and Elisha, thus protecting Judaism and the Jewish people from assimilation and consequent disappearance. Nevertheless, certain of the ancient prophets were either exclusively or partially moral teachers and preachers as well. Micaiah ben Imlah appears to have been a fearless prophet of the truth, who predicted dire consequences against Ahab even at the risk of death. Nathan sternly rebuked King David for the violation of the laws of morality and decency, and Elijah protested bitterly against Ahab's connivance at the brutal murder of Naboth by his Phoenician wife, Jezebel, and against Ahab's fostering of foreign deities and the consequent introduction of immoral and foreign religious customs and practices. Indeed, Elijah and Nathan represent the transition from the early prophets to the literary prophets.

Later Prophets. The great literary prophets, the first of whom appeared in the middle of the 9th century B.C., condemned the entangling foreign alliances, usually made on the basis of political or economic expediency, without regard to the rights of or justice to the people at large; they predicted the destruction of the Hebrew nation because of its political, moral and ethical sins, and the corruption of the higher, the priestly and ruling classes. These prophets protested against the sacrificial system and the complicated ceremonial code of the Temple, and decried the social injustice and oppression which were being exercised to the detriment of the lower strata of the population. They pleaded, in vain, for an end to such foreign political alliances, which they rightly regarded as immoral, for righteousness, personal morality, justice, peace among all nations, right conduct and scrupulous integrity towards the poor, the helpless, the orphaned and the widowed. They conceived of themselves as inspired by God to deliver their messages to the people, as being under some sort of inner compulsion to speak out what was in their minds, as being absolutely unable to refrain from giving vent to their innermost thoughts and convictions, even at the risk of rebuke, persecution, ridicule or death.

These later prophets prophesied the destruction of the nation within a short time, on the ground of the lack of moral guidance, the narrow-mindedness and the shortsightedness of the ruling classes, and declared that at the most a small "saving remnant" of the people would survive the general ruin of the Hebrew state and the overthrow of the Hebrew Temple with the sacrificial system. They declared that the day would soon come when God would demand and exact punishment from the kings, rulers and princes of the Hebrew nation for their moral sins, and not only for their moral sins, but their acts of injustice, cruelty and inhumanity. They pleaded for the restoration of the old, primitive religious piety of the early Hebrew nation, with its simplicity and sincerity, and were implacably opposed to the increasing luxury and extravagance and artificial practices of the higher strata of the population in their days.

It must be definitely emphasized that the great literary prophets were concerned solely with the events of their own times. They made no predictions for any remote future; but all their predictions were intended for the immediate future. They realized that the people and its rulers would not heed their warnings, would not give up their foreign alliances, would not practice simplicity and integrity even with certain world powers of their day. The prophets knew that the fall of the Hebrew nation was inevitable; this destruction they predicted solely on the ground of the terribly corrupt social, political and economic conditions which they saw prevailing about them; such moral, ethical and national predictions were the only prophecies they ever made. Their predictions were thoroughly vindicated, for both the Northern Kingdom and the Southern Kingdom were

soon destroyed, the kingdom of Israel in 721 B.C., and the kingdom of Judah in 586 B.C.

Later Judaism, realizing that the predictions of the prophets had actually come true, and that the destruction of the nation and of the Temple had actually come to pass almost exactly as the prophets had said, revered and cherished thenceforth the teachings and sayings of the prophets, who had been ridiculed, persecuted, disregarded and despised during their own lifetime. The later Jews thus based their new Judaism, prophetic Judaism, on the great moral, social, ethical and spiritual teachings of the prophets, which contained no dogmas. The doctrines of prophetic Judaism have survived even to-day, and form the greatest part of the Jewish religion; for the principle of ethical monotheism is to-day the basic feature of Judaism, far outshadowing the later rabbinical and ceremonial accretions. A. SH.

BIBLIOGRAPHY—Moses Bottenwieser, *The Prophets of Israel*, 1914; W. Robertson Smith, *The Prophets of Israel*, 2nd ed., 1919; Harold M. Wiener, *The Prophets of Israel in History and Criticism*, 1923.

PROPIONIC ACID, a colorless, liquid substance ($C_3H_6O_2$) with a pungent odor resembling that of acetic acid. It occurs in the juices of the stomach, in perspiration, and in the blossoms of certain plants, including milfoil. It is of the monobasic fatty series. Its salts are called propionates, as sodium propionate ($NaC_3H_5O_2$).

PROPORTION. If four magnitudes a, b, c and d are in a relation defined by the equality of the ratios of a to b and of c to d , then these magnitudes are *proportional*, and the relation is a proportion. Symbolically this is expressed as $a:b = c:d$ or $\frac{a}{b} = \frac{c}{d}$. This

relationship leads to an ancient rule, known as the **RULE OF THREE**; i. e., the fourth proportional can be found if three terms are given. Thus, $a = bc/d$. This kind of proportion, also known as geometric proportion, is discussed in Book V of *Euclid*. An arithmetic proportion is an expression of the equality of the consecutive differences between each pair of numbers taken in an arithmetic progression in the following manner, $12 - 9 = 9 - 6$. In the geometric proportion $a:b = c:d$, the terms a and d are called the extremes, and b and c are called the means. When the terms represented segments of a straight line, as among the Greeks, an old geometric rule stated that the rectangle of the means is equal to the rectangle of the extremes. When the terms began to be considered arithmetically, this was changed to "the product of the means is equal to the product of the extremes." With modern algebraic symbolism such rules have little more than historical interest. The uses of proportion are now chiefly confined to geometric, physical and trigonometric measurements, commercial problems being solved by better methods. See **RATIO**.

PROPORTION, a word coined by CICERO to render the Greek word *analogia*. It expresses a relation of elements which depend on one another and vary in like manner with regard to magnitude, de-

gree or quantity. In art the term is used with reference to the dimensions of a figure, and to state the relation of parts or elements of a composition to one another and to the whole.

Mathematicians have found certain fundamental proportions which are in evidence throughout natural phenomena, and forms built up by nature. They have also found that when these proportions are applied consciously or unconsciously to works of art the effect is pleasing to the eye. By studying the measurements of flowers, snow crystals, algae, butterflies, shells, pine-cones, the bee's honeycomb and the human form, the measurements of the action of sound and light waves, and gravity, together with great works of architecture such as the PYRAMIDS, the Parthenon, some of the cathedrals and paintings of the great masters, it has been found that all forms may be classified in three groups, with respect to proportion. These are the 1. four-sided or Tetragon group; 2. the group of Extreme and Mean Proportion and 3. the Asymmetrical group.

In the first group are the following geometrical forms: the square, the octagon, the equilateral triangle and the hexagon. Between these geometrical forms, drawn on the identical unit of base, there are the following relationships: the radius of the circle, the side of the second square, the side of the hexagon and the diagonal of the side of the cube are equal in length; the side of the equilateral triangle, the diagonal of the solid cube are of equal length; the side of the second square, the ends of the hexagon and the side of the equilateral triangle are coincident in position as measured from the center of the prime circle. Natural forms which fall into this group are snow crystals, diatoms (algae), butterflies, the bee's honeycomb, lilies, iris, poppies and single dahlias, and objects of art are the Arch of Titus, Section of the Pantheon in Rome, San Giovanni, Siena, etc. The proportions of these forms are identical with the proportions of geometrical figures in this group.

The pentagram is the perfect example of the second group, Extreme and Mean Proportion, sometimes called the Golden Series. Forms in this group are in such proportion that *of two separate quantities, the lesser is to the greater as the greater is to their sum*. An approximate numerical expression is the series 1:2::2:3, 2 3::3:5, 3:5::5:8, etc. The pentagon with the pentagram and all quantities and lines which are in the ratio of extreme and mean proportion are the forms which constitute this group. Natural forms belonging to this group are the starfish, crinoids, the pitcher plant, the wild rose, woodbine, the foot of a hound. The bone structure of the human body, both in its parts and as a whole, is a striking example of this ratio, also existing in the realm of art in the cathedrals of Amiens and Notre Dame, Paris, the west front of Exeter Cathedral, the portal of San Donnino of Emilia, in the paintings of *The Entombment* by TITIAN, the *Madonna of the Cradle* by RAPHAEL and numerous others.

The Asymmetrical is a variable group "in which

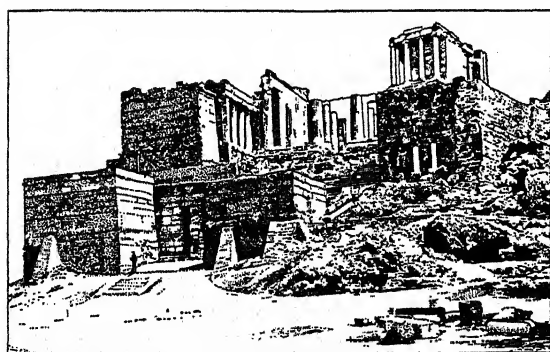
the focal position and the radial length or both constantly vary." This group includes catenary curves, ellipses, eccentric circles and the spirals. Objects classified in this group are the spider's web, pinecones, the sunflower capitulum, the snail, the nautilus, and among art objects are ancient Greek urns (designed on the ellipse), the winding stairway of the Palazzo Contarini del Bovolo, Leonardo's stairway at Blois, patterns in certain Chinese rugs and many famous paintings in which the composition is plotted on asymmetrical spirals.

PROPORTIONAL REPRESENTATION, a method of electoral procedure designed to remedy the defects of the present single member election district system of electing members to representative assemblies. Two outstanding variations of the reform contend for acceptance, the List system and the Hare system. Both demand the substitution of a multi-member election district for the existing ones. Under the List system each party would put up its list or ticket, and would receive an allotment of seats in the legislature proportional to its total vote at the polls. The List system works an injustice, however, to the independent voter whose thinking does not run along party lines. It is for this reason that the Hare system has been chiefly advocated in the United States, and is in fact the only system of proportional representation in actual operation there. S. C. W.

BIBLIOGRAPHY.—Hoag and Halleck, *Proportional Representations*, 1926.

PROPOSITION, a statement placed before (Latin *pro*, before, + *ponere*, to place) a person for consideration. In mathematics it is a statement of something to be proved, a theorem; or something to be done, a problem. In geometry the latter is a construction to be effected. See **THEOREM**; **PROBLEM**; **GEOMETRY**.

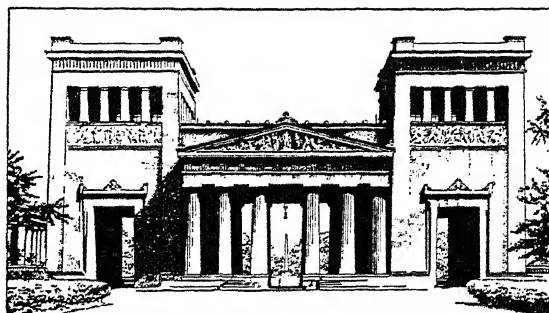
PROPYLAEA, a Grecian gate-building, generally built as an entrance to an important or sacred precinct. The word is often used for the gate of the Acropolis



PROPYLAEA OF THE ACROPOLIS, BEFORE RESTORATION

of Athens, which is noted for its beauty and originality. It consists of a portal proper with extensive wings on either side and was built of Pentelic marble after a design by Mnesicles in 437-432 B.C. The structure is wholly Doric in character except for six Ionic columns which support the interior of the roof. The

central portion has a cross wall cut by five entrances, the center one being sufficiently wide to accommodate chariots. Various modern, monumental gateways are



PROPYLAEA AT MUNICH

called propylaea, such as the Propylaea at Munich, by Gärtner and Von Klenze.

PROPYL ALCOHOLS. See **PROPANOL**.

PROROGATION. See **DISSOLUTION**.

PROSE, the term for ordinary language in its written form, wholly unrestricted by any rules of versification such as apply to **POETRY**. Conversation is the direct forerunner of prose, notwithstanding that conversation is not itself prose, since the word applies only to written and not spoken language.

Although prose is an extremely free literary form in comparison with poetry, it nevertheless has certain rules of its own. Grammatical correctness is the first. Further requirements demand that the written sentences shall possess clarity so that the writer's meaning shall be comprehensible, and conciseness, so that it shall be conveyed to the reader in as direct a manner as possible. But prose may be grammatically correct and possess both lucidity and conciseness, and yet be dull, disagreeable, monotonous, heavy and lacking in harmony. It is precisely at this point that the elusive problem of what is called literary style enters into the question.

Writers and students of literature have never tired of attempting to probe the mysteries of prose style. Some writers possess style, and others, writing equally correctly, do not. It would seem that a pleasing arrangement of words and sentences making for style, is far more an innate gift than an acquired talent. So, at least, thought **BUFFON**, whose famous definition, "style is the man himself," is always quoted and seldom attacked. Some critics believe that it is so personal a quality that one cannot acquire it, and that the best a writer can do is to set down his prose as simply and naturally as possible without taking thought as to whether or not what he writes possesses real prose style. Others believe that the constant study of the best prose models can do much to develop this quality, although it is agreed that downright imitation is the negation of style, since one of its characteristics is the personal element.

As masters of beautiful prose writing the Greeks have never been surpassed; many literary critics believe that the prose of **PLATO** has never since been

equalled. Among modern nations the French are the recognized masters of prose style. For centuries they have taken profound pride in their language and to-day French prose is unmatched in all that makes for lucidity, grace, polish and charm. VOLTAIRE, with his plain, simple, short sentences, clear and apparently effortless, is usually regarded as the first of prose writers in that language, and J.-J. ROUSSEAU, RENAN and ANATOLE FRANCE each command the respect of all lovers of fine prose. Americans and English have always been less preoccupied by the manner, as distinct from the matter, of prose, and for sheer perfection of style there are few English writers who can compare with the leading French. The best examples of fine English prose are probably the King James *Authorized Version* of the Bible, the works of Gibbon, Goldsmith, Thackeray, Pater and, in America, Washington Irving, Hawthorne, Thoreau and James Russell Lowell. See also GREEK, ENGLISH, AMERICAN, FRENCH LITERATURE.

BIBLIOGRAPHY—J. Earle, *English Prose*, 1890; L. Cooper, *Theories of Style*, 1907, G. Saintsbury, *History of English Prose Rhythm*, 1912; J. M. Murry, *The Problem of Style*, 1922; J. W. Beach, *Outlook for American Prose*, 1926.

PROSERPINE, in Roman mythology, the wife of PLUTO and Queen of Hades. See PERSEPHONE.

PROSPECTING or exploration, a mining term descriptive of the art of searching for valuable MINERAL DEPOSITS. Prior to the development of geological science the discovery of new ORE DEPOSITS was practically limited to those outcropping, that is showing visible signs of their presence at the surface of the earth. Through the processes of WEATHERING and EROSION even those formed at great depths beneath the earth's surface may eventually become exposed. Although these same processes may alter the appearance of the ore itself, so that the outcrop shows little sign of what lies beneath it, experience soon taught what to expect in such cases. Knowledge of the types of rocks apparently favorable to the occurrence of ore in known mining districts frequently aided the prospectors in the location of new ore bodies in unproven areas. Though unversed in the science of geology, prospectors frequently built up an empirical knowledge of some of the geological phenomena associated with ore occurrences, which were of aid to them in their quests.

The rapidly accelerating demand for metals (see MINING, METAL) which has accompanied the industrial development of the modern age has brought about an intensified search for new ore. As a result, most ore deposits easily discoverable by superficial search have been found, at least in readily accessible portions of the globe. Consequently, improved techniques are now required in order to locate concealed ore deposits, and the geologist is increasingly called upon for this task.

Before undertaking to prospect a given area, certain broad factors must be considered. In the first place, the area must not be so inaccessible that there is no hope of finding deposits of sufficient size and richness

to stand the high costs of development, mining and transportation. Secondly, the general geology must be such as to warrant a belief in the possibility of the desired ore occurring in that district. Thirdly, the ore searched for must be in demand, and must be able to meet competition from sources already developed. Fourthly, the mining laws must be such as to assure peaceful possession and unhindered exploitation.

The detailed examination of a chosen area requires close study of all available geological information. Previous reports and available data on the region should be investigated. In some cases, the geologic and mineralogic characteristics of the mineral deposits over a considerable area may show close relationships and similar origin. This is called a "metalogenic" or "metalographic province," and provides a guide to what may normally be expected in the district. The study of the kinds of rocks occurring in any area, and their relationships to one another, their structure, the alteration they have undergone either by weathering or metamorphic action of intruding IGNEOUS ROCKS (see METAMORPHISM), the amount of shattering they have suffered, all serve as indications to the geologist as to where to search for definite signs of concealed mineral deposits, such as ORE, COAL, and PETROLEUM. Of great importance is a clear conception of the origin of various types of ore bodies, for without this it is impossible to visualize the factors that favor the deposition of the ore and its localization in certain surroundings.

In recent years the science of GEOPHYSICS has been called on to aid the geologist in discovering concealed ore. To this end the hidden formations are studied by means of their magnetic properties, their effect on electrical currents, and their density and elasticity. Through these effects concealed geological relationships are frequently revealed which permit making a reasonable deduction as to where ore deposits might be expected. With the discovery of ore the problem shifts to one of MINE DEVELOPMENT and MINE EXPLORATION. See also SECONDARY ENRICHMENT; PETROLOGY.

S. F. K.

BIBLIOGRAPHY—C. G. Gunther, *The Examination of Prospects*, 1912, Max W. von Bernwitz, *Handbook for Prospectors*, 1931.

PROSPECT PARK, a borough of Passaic Co., N.J., situated on sharply rising ground overlooking the Passaic River and 14 mi. northwest of the New Jersey terminus of the George Washington Memorial Bridge. It is served by motor bus lines connecting it with the railroad facilities of Paterson and of Hawthorne, N.J., which it adjoins on the west. It is strictly a residential suburb. Pop. 1920, 4,292; 1930, 5,909.

PROSPERO, in Shakespeare's *THE TEMPEST*, the rightful Duke of Milan, has been banished to a desert island where he practices magic. Years later he raises a tempest which wrecks Antonio, his usurping brother, Alonso, king of Naples, and the latter's son Ferdinand. Prospero's daughter Miranda falls in love with Ferdinand, the two brothers are reconciled, and Prospero is restored to his dukedom.

PROSSNITZ. See PROSTĚJOV.

PROSTĚJOV (*Prossnitz*), a city in Moravia, Czechoslovakia, about 25 mi. from Brno. There is considerable manufacture of textiles, baskets, straw hats, brandy, beer, malt, cheese, agricultural machines and an active trade in grain, especially in barley. Overlooking the city on an immense crag is the imposing Liechtenstein castle. Pop. 1930, 33,487.

PROSTITUTION, the act of prostitution of the body for gain. The practice has existed from earliest times, and has always been regarded as an evil. In all ages governments have experimented with attempts toward its control, unsuccessfully for the most part. In Europe regulation and other systems have developed, varying widely from country to country. In America control of morals generally, and of prostitution, has differed according to the temper of the people of the several states and their social and political antecedents. In the 19th century an attitude of toleration in many places, as well as the policy of regulation, resulted in the rapid growth of prostitution, accelerated further by the concentration of people in cities.

Many changes have occurred in most countries in the world, not only in the public attitude toward prostitution but in the character of the laws and measures directed against it. At one time regulation prevailed over almost the whole of Europe. By regulation is meant the series of restrictions placed upon the activities of a woman prostitute by the police, including registration of name, and necessity of her appearance for periodic medical examination, in return for which she is virtually licensed to operate. This system no longer exists in Great Britain, Germany, Holland, Denmark, Norway, Switzerland and the United States. In other countries such as France, Belgium, Austria, Hungary, Sweden and Italy, it is not in vigorous operation. The reason for its decline has been the general recognition that neither objective is attained under operation of the system.

In the United States there was no great change in the situation until the early years of the 20th century. The beginning of international cognizance of the problem together with the long series of vice commission investigations began with that of Chicago in 1910. It was realized for the first time that prostitution is a business operating according to the economic laws of supply and demand.

Upon the entrance of the United States into the World War, the Secretary of War was authorized by Section 13 of the act providing for the National Army, 1917, to suppress prostitution in effective zones about military places—a new policy for the military forces of the United States.

In 1919, the first law was passed penalizing the man customer of the prostitute. This defined prostitution to include "the giving or receiving of the body for hire, or the giving or receiving of the body for indiscriminate sexual intercourse without hire." In 1931 13 states included this definition in their vice repressive laws.

Since the World War there has been a general trend

of public opinion toward a continuous program of repression to reduce commercialized prostitution to a minimum, as the only practical method for the control of such vice. No state allows the licensing of houses of prostitution by law or city ordinance except Nevada. All the 48 states have legislation directed against third party commercial exploiters of prostitution, and most of the states have laws penalizing the prostitute and her customer. Another group of laws make provision for the control of venereal diseases.

Early in the 20th century the nations of the world began to take joint action against prevailing conditions. The International White Slave Conference in Paris, in 1902, was followed by the treaties of 1904 and 1910. The League of Nations on its establishment was entrusted with general supervision over the execution of the agreements with regard to traffic in women and children, and in 1923 appointed a body of experts to study the subject. The resulting report disclosed the existence of a considerable amount of traffic, particularly between Central Europe and Central and South America. M. S. E.

BIBLIOGRAPHY—H. B. Woolston, *Prostitution in the United States*, T. W. Galloway, *Sex and Social Health*, League of Nations Report of the Special Body of Experts on Traffic in Women and Children, Parts I and II.

PROTECTION AND FREE TRADE. In economic terminology protection refers to the general policy whereby a nation attempts to aid its domestic producers in meeting foreign competition. Assistance is given usually through the imposition of taxes on IMPORTS, although sometimes it involves the outright prohibition of imports. Less frequently governments also give bounties on EXPORTS. Free trade, on the other hand, is non-interference with foreign commerce. It should not be assumed that the mere existence of CUSTOMS DUTIES necessarily implies protection. Duties for revenue purposes only are not at all inconsistent with free trade. Generally, a duty that gives a high degree of protection will not yield much revenue because of the fact that protection requires rigid limitation on imports while substantial receipts of revenue are secured only from large imports.

The most complete protective system the world has ever experienced arose during the régime of Mercantilism just before the dawn of modern industrialism. The reaction from the onerous restrictions of this system was accompanied by a wave of free trade sentiment that caused most countries materially to reduce their protective tariffs. The free trade movement culminated in England about the middle of the 19th century with the virtual abandonment of import taxes except for revenue purposes. The United States, however, adopted protection soon after the War of 1812 and in spite of considerable variation in the degree of protection has maintained it ever since.

Since the World War, the protectionist philosophy has made many converts with the result that tariff walls are higher than at any time since the abandonment of Mercantilism. Even Great Britain has imposed protective duties on some commodities.

The controversy over the merits of the protective program is one of the oldest and most bitter in American history. The continuous agitation for further protection coupled with widespread misconception in regard to its true effects has created a vacillating public opinion in regard to its merits.

The alleged advantages of protection are legion. Following are the ones usually advanced: 1. It promotes a favorable BALANCE OF TRADE which, in turn, means greater merchandise exports and larger GOLD imports. 2. It diversifies industry and thus enables a country to avoid the dangers of over-specialization. 3. It prevents wages from falling to the level of foreign countries, an inevitable result of free competition. 4. It enables industries to become established which will eventually be quite able to meet foreign competition although temporarily unable to do so. 5. It assures domestic producers of at least the home market. 6. It fosters industries necessary in time of war. 7. The readjustments caused by a radical change would be unfair to the many industries that have long received protection as well as harmful to society at large.

The case of those who oppose protection can be resolved to three main points. First, they believe that free trade must be presumed to be the proper policy until the contrary is demonstrated and that the burden of proof, therefore, falls on the advocates of protection. Second, they deny that the alleged benefits actually can be realized and hence claim that the protectionists do not meet this burden of proof. Third, they cite certain positive disadvantages of protection.

In regard to the first point, free traders claim that the experience of mankind shows that government interference with trade is in general a poor policy. Restrictions similar to those embodied in a protective system would be intolerable in domestic trade and the existence of a boundary line is not sufficient reason to change the presumption in favor of free trade.

Free traders also believe that supporters of protection have not met their burden of proof because the alleged advantages have no basis in fact. In regard to the balance of trade argument they point out that after all a country gains more from imports than from exports inasmuch as the former bring wealth into the country while the latter take it out. In regard to the gold idea they call attention to the fact that beyond a certain point gold has no value to a nation beyond its use in purchasing further imports. They also point out that the balance of trade of a nation is the result of many complex forces and can be little affected by a protective tariff. Curtailment of imports will usually require a similar curtailment of exports.

Against the diversification argument it is objected that diversification by itself is no particular advantage and that the United States with its varied natural resources would have wide diversification regardless of its tariff policy.

The point of the protectionists that has carried

most weight is probably the high wages argument. This seems to be one of their least valid contentions, however. It is questionable whether a generally high wage level means high costs of production. If so, then it is true that a nation might be temporarily handicapped. This cannot continue long, however, because gold would flow out of the country to pay for imports with a consequent drop in prices. It is possible that the level of money wages might fall, but the standard of living would not.

The infant industries argument is generally given a limited validity even by free traders. It is possible to assist an industry to get established. On the other hand, the number of industries that can be put in the infancy class is very small. The difficulty with the home market argument lies in the fact that to the extent that protection eliminates foreigners from the domestic markets, it also reduces the quantity of goods that they can buy. Free traders believe that a country would be better off to have access to foreign markets and permit foreigners to enter its markets. The military argument is usually dismissed on the grounds that a direct BOUNTY would be much better than the tariff (*see* TARIFF COMMISSION) as a means of aiding those industries necessary in time of war. Finally, it is generally agreed that the change to a free trade policy would cause a considerable readjustment and that this would be accompanied with some hardship. This is hardly a justification, however, for the continuance of a policy that otherwise would be undesirable. Most of the ill effects could be avoided by a gradual lowering of the tariff rates.

Among the specific disadvantages of a high tariff policy cited by free traders are that it reduces the effectiveness of capital and labor by encouraging them to enter employments less remunerative than those in which they would engage under free trade; it reduces the advantages of specialization and the interchange of goods; it hinders the payment of international obligations which must be made in the long run largely through the shipment of goods; it awakens international distrust and dislike; and it prevents the easy adjustment of economic conditions between nations required by the intimate commercial relations at the present time.

A. F. L.

BIBLIOGRAPHY.—F. W. Taussig, *Free Trade, the Tariff and Reciprocity*.

PROTECTORATE, a term used to cover a wide variety of relationships. In general "the protectorate is a state which has by formal treaty placed itself under the protection of a stronger state, surrendering to the latter the control over its foreign relations, while retaining a large measure of control over its domestic government" (Fenwick). Frequently control is extended to the financial affairs of the protectorate (*see* PROTECTORATE, FINANCIAL). In all cases the protecting power becomes responsible for the protectorate's fulfillment of its international obligations.

BIBLIOGRAPHY.—C. G. Fenwick, *Wardship in International Law*, 1919.

PROTECTORATE, FINANCIAL, a term now used in INTERNATIONAL LAW to indicate a relationship between two states in which one exercises a measure of control over the financial administration of the other. The degree of control thus exercised varies from situation to situation. It may be limited to the making of foreign loans; it may apply to the administration of a particular revenue; or it may extend to the operations of the entire fiscal system. The American protectorate over Haiti and Nicaragua may be said to fall into this general category.

PROTEIN HYPERSENSITIVENESS. See ALLERGY.

PROTEINS. Living substance, called protoplasm, is a mixture of chemical compounds which are of constant composition in different samples of the same material. These substances are classifiable into a small number of groups. They are CARBOHYDRATES (sugars), lipoids (oils, fats, waxes), and proteins, together with water and small amounts of inorganic salts.

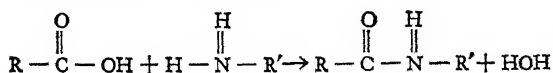
When the carbohydrates and lipoids have been dissolved from a sample of recently living material, a mass of insoluble sludge remains. This constitutes the protein fraction. When such a residue is analyzed, approximately half of it is found to be carbon, one quarter is oxygen, and the remaining quarter is nitrogen (15% of the whole), hydrogen (7%), and small amounts of sulphur and phosphorous.

Samples of protein from different sources give a positive reaction to certain chemical tests. No substances other than proteins will react to a majority of these tests.

The residue referred to above is usually composed of a mixture of proteins. Now, if the exact structure of a compound is to be determined, it must be obtained pure. The best way to be sure a compound is pure is to crystallize it. To separate the proteins from one another, constantly increasing amounts of salts are added to a suspension of them. This is known as salting out. At definite concentrations certain proteins will coagulate or precipitate out. Then they are sometimes crystallized, though this is usually difficult.

If, now, the pure protein is hydrolyzed, that is, broken apart by means of water, generally with the assistance of heat, chemicals, or enzymes, an assortment of not over eighteen simpler compounds are yielded. These building stones of the proteins have many characteristics in common. All have an amine group ($-\text{NH}_2$) and a carboxyl (acid) group ($-\text{COOH}$). For this reason they are called amino-acids. Obviously a knowledge of the composition and action of the amino-acids is fundamental to an understanding of the activities of protoplasm. The composition of each is exactly known.

In a protein they are joined to one another by the amine group combining with the carboxyl group, with the loss of water, thus:



This is called the amide linkage. Artificial proteins, called polypeptides, have been made synthetically.

Since the amine group is basic in its reaction and the carboxyl group is acid, we should expect proteins to act both as acids and bases. Such is the case, and accordingly, proteins are amphoteric. The physical characteristics of a protein vary with different degrees in its reaction. When the reaction has reached a certain point, varying with the protein, it tends to precipitate, and its viscosity, osmotic pressure, conductivity, and water and ash content are at a minimum. This point is the iso-electric point.

The protein molecule is complex and consequently large. Albumin, the protein of white of egg is $\text{C}_{936}\text{H}_{1128}\text{N}_{175}\text{S}_8$. A myriad of proteins with such a combination of atoms is possible. Similar proteins of different species, and perhaps of different individuals of the same species, differ in their configuration.

The multiplicity of proteins led to attempts at their classification. According to the most current system (U. S. system) they are divided as follows:

I. Simple proteins: protamines, histones, albuminoids, prolamines, glutelins, globulins, albumins.

II. Conjugated proteins. Those combined with non-protein groups: chromoproteins, glucoproteins, phosphoproteins, nucleoproteins, lecithoproteins.

III. Derived proteins. Partially broken down proteins: proteans, metaproteins, proteoses, peptones, peptides.

Due to the large size of the protein molecule, these substances do not form true solutions in water. Rather they possess some properties of a suspension of very minute particles. Such a suspension is called a COLLOID. The properties of colloids are complex and interesting. They are the basis of much that is of paramount fundamental and practical value in chemistry and biology. See AMIDES; AMINES. W. J. S. K.

Proteins in Foods. Proteins are compounds of carbon, oxygen, hydrogen and nitrogen. Some also contain sulphur, phosphorus or iron. There are more than 50 of these substances known, all different, and very complex, but all of them made by the union of simpler organic nitrogenous compounds, called amino-acids. A protein may contain as many as 18 or 20 different amino-acids. In the digestive tract meat, egg, fish, cereal and vegetable proteins are broken down into the amino-acids of which they are composed. These are absorbed into the blood, from which each cell in the body withdraws the kinds and amounts of amino-acids needed to build or repair the specific proteins characteristic of that kind of tissue.

Feeding tests with albino rats have demonstrated that some of these amino-acids must be provided for the maintenance of weight (repair of tissue) in adult and growing animals and are required in larger amounts for growth (construction of new tissue), while others are either not indispensable or can be made by the body itself from other substances.

If a single protein is fed, its value in nutrition is limited by its lack of any essential amino-acid. Zein,

one of the proteins of the corn kernel, is an example of a protein which is inadequate for either growth or maintenance when used as the sole protein in an otherwise satisfactory diet. If the amino acid tryptophane (not found in zein) be added, it becomes adequate for maintenance; with the further addition of lysine, the ration permits normal growth. However, corn contains other proteins which are capable of supporting maintenance and growth, and which make good the deficiencies of zein. Gelatin is another protein which is itself inadequate for maintenance or growth, because it lacks tryptophane and tyrosine and has very little histidine and cystine. It does contain some essential amino-acids, and, if combined rightly, each protein will supply the amino-acids lacking in the other. In a similar way, the groups of proteins contained in most foods do not show as striking differences as do individual proteins fed alone, but nevertheless, the protein mixtures in different foods are not of equal nutritive value. Those of MILK, CHEESE, EGGS, MEAT and other flesh foods are very efficient, and supplement effectively the proteins of cereals and vegetables which are somewhat less so. (See also DIET AND DIETETICS.)

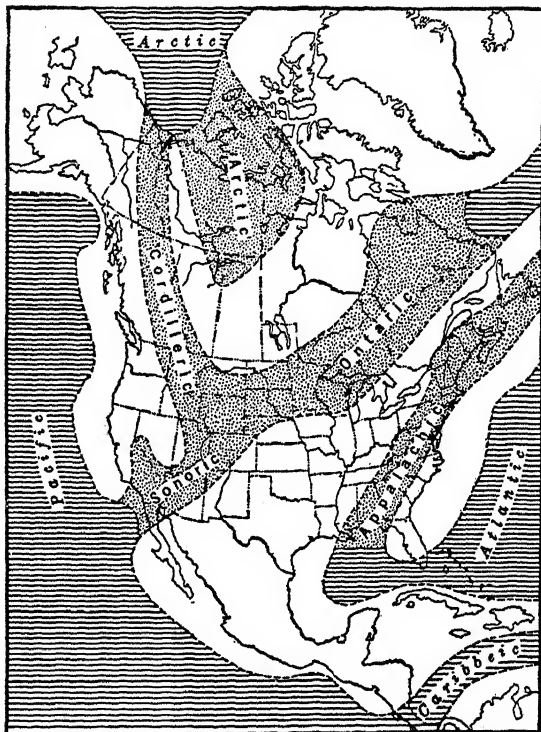
H. T. B.

BIBLIOGRAPHY.—H. C. Sherman, *Chemistry of Food and Nutrition*, 1924; A. P. Mathews, *Physiological Chemistry*, 1925; E. V. McCollum and N. Simmonds, *Newer Knowledge of Nutrition*, 1925; L. B. Mendel, *Nutrition: The Chemistry of Life*, 1923.

PROTEROZOIC, the second era in geological history, following immediately after the ARCHEOZOIC with which it constitutes Pre-Cambrian time. The igneous activity or VULCANISM, a symptom of crustal unrest, which so dominated the Archeozoic, quieted down, presumably with the thickening of the crust on the cooling earth. The Proterozoic is marked by a dominance of SEDIMENTARY ROCKS, intercalated with some local LAVA flows. FOSSILS, so markedly absent in the first era, are sparingly found in Proterozoic rocks. The name given this division of geological time means "Early Life."

Rocks of Proterozoic age usually occur with those of Archeozoic time, so the localities where they are exposed at the surface are, in the main, the same. These formations have been well studied in Canada, in the area around Hudson's Bay, stretching down to the St. Lawrence, and into the United States around the Great Lakes. The first sediments laid down on the eroded surface of the Archeozoic formations are called the Sudburian and Temiskaming series. These were then intruded by the so-called Algoman Granite, bringing with it most of the rich gold and copper deposits which are now among Canada's great sources of wealth. This may have accompanied the formation of an east-west mountain system across much of eastern and central Canada. The present "height of land," the insignificant ridge which separates the Hudson Bay from the Great Lakes-St. Lawrence drainage system is possibly the remnant of the roots of such a mountain chain; the gold and copper deposits referred to above are usually found near this "height of land" ridge. A long interval of erosion

followed, in which the area was reduced practically to a peneplain, much as it is now. By some authorities this is considered to mark the division between the Archeozoic and the Proterozoic. The next series of rocks, called Huronian because so well developed around Lake Huron, consist largely of sediments, metamorphosed into quartzites, slates, and schists. Some lava flows and igneous intrusions are found with them. One of the most surprising discoveries made in these Huronian sediments was the occurrence of glacial deposits, long since metamorphosed into solid rock. The evidence is clear, however, that this early in the



FROM CHARLES SCHUCHERT, OUTLINES OF HISTORICAL GEOLOGY, JOHN WILEY & SONS

LATE PROTEROZOIC GEOSYNCLINES AND LANDS

North America during the later Proterozoic, showing the three geosynclines: (1) Appalachian, (2) Cordilleric, and (3) Ontaric-Sonoric. The fourth seaway (Arctic) appears not to have been a geosyncline, but rather a transgressional sea similar to those of the Paleozoic

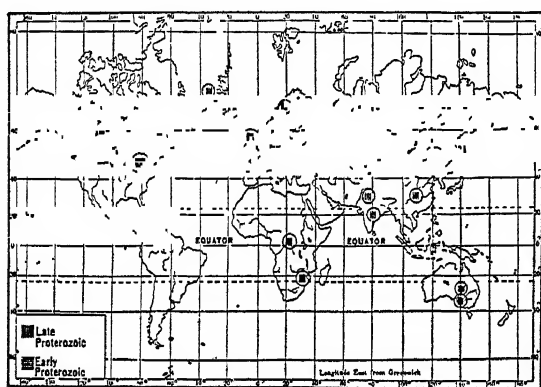
earth's history there were climates cold enough to produce Ice Ages. Glacial deposits in the Proterozoic rocks of Norway, Africa, India, China, and Australia bear witness to the presence of great ice sheets in many parts of the earth during the era.

Following the Huronian, came the Animikie series of sediments, and then later local eruptions of lava which, in places, attained a thickness of six miles. These flows, with the associated sediments, are known as the Keweenaw. On the Keweenaw Peninsula, in Lake Superior, native copper was later deposited in the pores, or AMYGDULES, of the lavas, and as a cement in the CONGLOMERATES, making one of the richest copper deposits on the continent. The silver veins of Cobalt, Ontario, came with the igneous

rocks of this period, and some the tremendous iron ore deposits around Lake Superior were precipitated from waters which had leached the iron from Proterozoic lavas.

On the basis of the uranium-lead content, the Proterozoic rocks are about 600 million years old, and the era lasted for 25% of all geological time. The Pre-Cambrian must have been longer than all subsequent time. More than half of evolution's course was run then, unrecorded and lost because life was presumably in the form of soft bodied, marine organisms, incapable of preservation as fossils. By the end of the Proterozoic hard shells appear, preserved as fossils. These and fossil worm tunnels, indicate a life already high in the evolutionary scale, including crustaceans, brachiopods, and annelid worms.

The lava outpourings of the Keweenawan were soon followed by more intense igneous activity and crustal unrest, which built new mountain systems from



CHARLES SCHUCHERT, OUTLINES OF HISTORICAL GEOL. (WILEY)

AREAS OF EARLY AND LATE PROTEROZOIC GLACIATION

the Great Lakes region southwards to Oklahoma, and in Arizona and the region from Virginia to Alabama. Thus the Proterozoic ended.

The name Algonkian is also given to this era. See also GEOLOGY; GEOPHYSICS; ORE DEPOSITS; PALEONTOLOGY; EVOLUTION; PALEOZOIC; METAMORPHISM; GLACIATION; ICE AGE. S. F. K.

BIBLIOGRAPHY.—W. A. Parks and A. P. Coleman, *Elementary Geology with Special Reference to Canada*, 1922; A. P. Coleman, *Ice Ages, Recent and Ancient*, 1926; Charles Schuchert and Clara M. LeVene, *The Earth and Its Rhythms*, 1927

PROTESILAUS, in Greek mythology, a Thessalian hero, son of Iphiclus and Astyoche, and husband of LAODAMIA. He was the first Greek to step ashore in the expedition against Troy and the first to be killed. Laodamia so grieved at his death that she begged the gods to allow him to return to life, if only for three hours (or days). This they did. When the time was up, Laodamia accompanied her husband on his second journey to the other world.

PROTESTANT EPISCOPAL CHURCH IN THE UNITED STATES, THE, is the continuation in unbroken line of the CHURCH OF ENGLAND, as that Church existed in the 13 Colonies before the American Revolution. While the separation of this

American Church from the Anglican Church necessarily followed the separation of the Colonies from the Mother Country, yet the daughter Church has not departed from the basic principles of the Mother Church in England. She accepts the same Scriptures, believes and recites the identical Creeds, uses a Book of Common Prayer of an entirely similar scheme, and possesses the same three-fold order of the Ministry, bishops, priests and deacons. It is only in organization for practical administration that the Protestant Episcopal Church differs from the Anglican body, and there the differences are striking and profound, as striking and profound differences in problems and conditions have necessitated. While it is quite true that the Prayer Book of the Church of England was used in several places as the English occasionally landed on our coasts, yet the first permanent establishment of that Church upon this hemisphere was not possible until that first lasting establishment of an English colony of Churchmen, apparently to a man, was accomplished at Jamestown, Va., May 13, 1607. There, three days later, the Chaplain, Rev. Robert Hunt, conducted public worship from the Book of Common Prayer, and there the Holy Communion, according to the Anglican rite, was for the first time celebrated in this Western world, Sunday, June 21, of that same year, it being the Third Sunday after Trinity.

From 1607 until the opening of the 17th century the affairs of the Church of England in the Colonies were administered by commissaries sent from overseas by the Bishop of London, who, until the American Revolution, acted as diocesan of all the scattered parishes. These commissaries were Rev. JAMES BLAIR, founder of William and Mary College, 1693, and Rev. Thomas Bray, who in 1701 founded the Society for the Propagation of the Gospel in Foreign Parts, commonly known as "S.P.G." or as the "Venerable Society," the purpose of which was the care of the Church in the Colonies. Dr. Blair and Dr. Bray and many of the missionaries sent out by S.P.G. were men of a heroic mold and of truly apostolic character. But conditions were against them, for the Church, possessing no bishops on the ground, was incomplete in organization. So neither confirmations nor ordinations could be held this side of the Atlantic, and few of American birth had either the means or the courage to brave so dangerous and uncertain a voyage even for such purposes.

Break from Mother Church. The Churches in the Colonies petitioned the Mother Church that a bishop be sent them, and there were those in the Mother Country who felt the force of the appeal. But nothing came of the efforts, largely from an apprehension in England that the presence of a bishop in the Colonies would increase the tension growing up between them and the Parliament, especially in Puritan New England where the mitre and the Crown were identified, and alike detested and feared. But by the day of Concord Bridge there were parishes of the Church in every one of the 13 Colonies, and

in Virginia and in Maryland, and practically in New York, the Church of England was by civil law established. But for the Church in the Colonies the wrench from the Mother Church in England which the success of the Revolution produced was more violent and drastic, and the situation was even the more serious than was that in the civil government and in politics. She was left not only without bishops and without the generous financial support of S.P.G. in colonies where the Church was not established, but for the fact that so many of her clergy from their English birth, training and ordination had been so pronouncedly Tory, she stood in many sections discredited. And further, except in Virginia and Maryland, so far separated from one another and so difficult were the means of communication between the parishes, that the corporate life and the union in Church government which alone could make for her further and permanent existence seemed even to many of her most devoted sons, quite beyond the possible. The hour then struck for the birth of an autonomous Church in this Western land, in communion with that ancient body over the seas. And the hour did not strike in vain.

The necessary brevity of this article prevents giving in detail the processes which resulted in the organization of the Protestant Episcopal Church. To Dr. William Smith of Maryland the Church owes her Prayer Book, and to Dr. William White of Pennsylvania, her constitution. It was Dr. Samuel Seabury of Connecticut who first secured the Episcopate for America. He was elected to the office by a small group of the clergy of that state, who met at Woodbury, 1783. Dr. Seabury repaired to England seeking consecration which for several reasons he was unable to secure, chiefly because anyone so consecrated was obliged by law to take an oath of allegiance to the Crown. Parliament could have passed an ordinance omitting such an oath; but as Seabury came not from a national Church already established, but only from a small and obscure group of clergymen, such an ordinance seemed in his case unwise. Seabury then repaired to Scotland where he sought and obtained consecration from three bishops in the non-juring succession, in Aberdeen, Nov. 14, 1784. What was really the first meeting of General Convention of this Church was held on the call of Dr. White and others, in Christ Church, Philadelphia, Sept. 27, 1785. Shortly afterward, Dr. White and Dr. Samuel Provost of New York, having been duly elected by their dioceses, went to England, where because of obviously changed conditions, the ordinance of Parliament which had been denied Seabury, was passed for them, and where in Lambeth Palace Chapel, on Feb. 4, 1787, they were duly consecrated to the Episcopate. Returning immediately, they entered New York Harbor on Easter Sunday morning of that year.

Though now possessed of a complete organization and capable of self-support, self-government and self-perpetuation, yet the Episcopal Church felt that distressing reaction experienced by all Christian bodies

in this country after the Revolution. It is difficult to fancy what the future of this Church might have been were it not for the lives, efforts and achievements of four bishops consecrated in the early years of the last century; namely, John Hobart for New York, Alexander Viets Griswold for all New England, outside of Connecticut, Richard Channing Moore for Virginia, and John Stark Ravenscroft for North Carolina, whose accomplishments under the conditions have rarely been equalled in the history of episcopacy. To Hobart is owing the General Theological Seminary, New York City, and the college which bears his name in Geneva, N.Y.; and Moore was responsible for the beginnings of the Episcopal Theological Seminary, Alexandria, Va. A further evidence of the growing vitality in this Church in those days is found in her sharing in the movements which were then beginning mightily to influence the Mother Church in England; such as the Sunday School movement, the Missionary movement, the Social Service movement, and the Oxford movement, which resulted in High and Low Church parties in the body ecclesiastical. The year 1835 saw our first foreign missionaries, Henry Lockwood and Francis Hansen, both going out to China, and at a time near thereto, our first domestic missionaries, Philander Chase, in the Middle West, James Hervey Otey in Tennessee, and Jackson Kemper in the far Northwest.

Unity during Civil War. Through the war between the states the Church passed without a lasting scar, which can be said of scarcely another Christian body in our country. For whereas other bodies were cut in twain along politico-geographical lines, the Episcopal Church was not so divided by the conflict. One General Convention of the dioceses of the seceded states was held in the South during the war and one in the North, at which the roll of dioceses, beginning with Alabama, to which of course, no answer was given, was called as if there were no schism in the body politic which caused a practical schism in the body ecclesiastical. After Appomattox one by one of the dioceses of the South returned to the fold of General Convention and in a surprisingly short time the roster was again complete. Since the opening of the final quarter of the 19th century, the life of the Episcopal Church has been characterized by expansion at home and abroad, by the alteration of her former canons and the passing of new ones to meet the needs and conditions of a social and industrial life; by changes for similar purposes in her Book of Common Prayer, by an increased interest in church architecture, church equipment and church music, and by the building of cathedrals, parish churches and parish houses; and by the establishment of many societies, guilds and such like, among the lay people as well as the clergy, for a great variety of proper and timely purposes.

Administration of Church. The supreme legislative body of this Episcopal Church is General Convention, which since 1789 has met triennially, and which is bicameral, having a House of Bishops and

a House of Clerical and Lay Deputies, both houses being possessed of the right of initiating legislation, though the two houses must concur therein before any legislation can become operative and binding. To General Convention alone belongs the right of amending the Constitution and the Prayer Book. All such amendments may be voted upon finally only at the next General Convention, following that one at which they were proposed, and meanwhile every Diocesan Convention must be informed of any such impending change. The Presiding Bishop of the Church is the president of the House of Bishops. The chairman of the House of Clerical and Lay Deputies, who may be either a clergyman or a layman, is elected by that House from its own membership and holds office until the next stated meeting of General Convention. The House of Clerical and Lay Deputies is composed of four clergymen and four lay deputies elected thereto from and by every one of the several dioceses of the Church as they assemble in diocesan conventions; and of one clerical and one lay delegate similarly elected by every Missionary District, such being the dioceses of the Church which are not financially entirely self-supporting. The Diocesan Conventions meet annually, are presided over by the Bishop of the Diocese, and are composed of clerical and lay delegates, the former by virtue of their canonical residence within the diocese. A vestry is the governing body of a parish, of which the Rector of the Parish is president so long as he holds the office of Rector and the members of which are laymen elected by the qualified voters of the Parish in annual meeting assembled.

The administrative body of the general temporalities and material things of the Church is composed of the Presiding Bishop and Council, with headquarters in New York City. The Presiding Bishop is president of the Council. He takes orders for the consecration of new bishops. The Council consists of eight bishops, eight presbyters and eight laymen. The general work of the Council is carried on by departments, every one with its secretary, and as follows: Domestic Missions, Foreign Missions, Foreign Born, Social Service, Field, Religious Education, Freedmen, and Finance, and there is also a Speakers' Bureau, and a Woman's Auxiliary to the works of Missions at home and abroad.

The more striking features of the Episcopal Church which would indicate her expansion in the future would seem to be as follows: her organization, with rights and duties so clearly defined and definitely placed; the adaptability of her ministry to all manner of conditions; the place she gives to laymen in her councils; the richness and yet the simplicity of her liturgical worship, which though written and prescribed is yet so elastic, catholic and adaptable; the fact that she stands for principles rather than precepts, and that while she welcomes and receives all that is true in the new, yet she holds by all that is true in the old. In 1931 there were in this Church 1,287,431 communicants and 105 dioceses, of which 32 were missionary districts.

W.H.O.

PROTESTANTISM. The term Protestant, referring originally to those German states who signed the formal *Protestatio* at the Diet of Speyer in 1529, is now applied to all adherents of ecclesiastical bodies, which, in the 16th century, were set up in direct opposition to the Catholic Church, and to their successors down to modern times. The diet of the Holy Roman Empire, assembled at Worms in 1521, placed under ban MARTIN LUTHER (1483-1546), the founder of the reform movement, who had already been condemned by the papal bull of June 15, 1520. The reforming party of Luther was first granted legal toleration by the Recess by Speyer in 1526, which stated that until the time when the Edict of Worms, condemning Luther, be non-operative, each ruler should be at liberty to decide the religion of his state. This toleration had been gained during the absence of Emperor Charles V, who was at war with the French king, Francis I, and Pope Clement VII, thus allowing the reforming party to gain ascendancy at the diet. The result was the rapid spread of Luther's reformed faith in North Germany. In 1529, Charles V, having settled his difficulties with the French king and the pope, called a second Diet at Speyer, which abolished the territorial arrangement of the former Diet, and decreed that Catholics should be protected in Lutheran states, particularly in the exercise of the mass, but that Lutherans were not to be tolerated in Catholic states. Against these decrees 19 of the states of the empire, including some of the more important princes and imperial cities, protested, and their formal *Protestatio* caused them to be called "Protestants." The term soon came to be applied indiscriminately to all adherents of the reformed religion. In 1555 by the Peace of Augsburg Lutheranism was finally recognized in Germany.

In Switzerland the foundations of the reform movement were laid by a contemporary of Luther, HULDRICH ZWINGLI (1484-1531). His work, inaugurated at Zurich, was overshadowed by that of JOHN CALVIN (1509-64) at Geneva, which became the center from which his principles were spread to other countries. They were brought to Scotland by JOHN KNOX (1505-72). In England the papal jurisdiction was abolished under Henry VIII, and the Anglican Church established. The Lutherans spread mainly to Germany and to the Scandinavian countries; the Reformed or Calvinists spread to England, Switzerland, France, Holland, Scotland and Ireland. The membership in the Protestant Churches in 1932 was about 207,000,000.

For the history of the major Protestant Churches see BAPTISTS; CHURCH OF ENGLAND; CHURCH OF SCOTLAND; CONGREGATIONALISM; CONGREGATIONALISTS; GERMAN BAPTIST BRETHREN; CHRISTIAN SCIENCE; DISCIPLES OF CHRIST; LUTHERANS; METHODISM; PRESBYTERIAN CHURCH; PROTESTANT EPISCOPAL CHURCH; REFORMED CHURCH IN AMERICA; REFORMED CHURCH IN THE UNITED STATES; UNITARIANISM. See also THIRTY YEARS' WAR; REFORMATION, THE.

T. R. S.

PROTESTANT PROTECTIVE ASSOCIATION, in Canadian history, an anti-Catholic order

and offshoot of the AMERICAN PROTECTIVE ASSOCIATION. Its members were bound not to employ Catholics in any capacity if Protestants could be obtained, nor countenance the nomination of a Catholic to public office, nor to support any Catholic church or institution. The order was especially strong in Ontario, where it was popularly identified with the Conservative party. In 1894 it took up the MANITOBA SCHOOLS QUESTION, and declined after the Conservative defeat in the elections of that year.

PROTESTANT SUCCESSION, the principle according to which a person is ineligible for the British throne if he be a Roman Catholic or married to a Roman Catholic. The issue arose when the Catholic Mary Tudor, 1553, became queen. It assumed considerable significance at the time of Charles I and Charles II, becoming acute during the reign of the latter when his brother and heir, James II, was publicly received into the Roman Church in 1672. An EXCLUSION BILL, intended to prevent him succeeding to the throne, failed to become law. When, however, William and Mary became sovereigns, 1689, the Protestant Succession was included in the BILL OF RIGHTS, 1701, and it appears in the ACT OF SUCCESSION. As Prince of Wales, GEORGE IV evaded the act by marrying secretly but legally Mrs. Fitzherbert, a Catholic. At his accession, the sovereign swears an oath to maintain Protestantism and this pledge was offered, both by George III and George IV, as a reason for resisting CATHOLIC EMANCIPATION. The terms of the oath seemed to George V to be needlessly offensive to his Roman Catholic subjects, and Parliament, 1910, simplified the formula by ordaining that the sovereign declare himself to be "a faithful Protestant."

PROTEUS, in Greek mythology, the shepherd of Poseidon's flocks, who had the gift of prophecy. He came out of the sea at midday and, surrounded by sea monsters, reclined on the rocks. If anyone could catch him at this time he would foretell the future, but would assume different forms to avoid questioning. Proteus chose as his resting place either the island of Pharos or Carpathos.

PROTEUS. See OLM.

PROTOACTINIUM, a chemical element belonging to the radioactive group and the parent substance of actinium, which is formed out of it by the loss of a helium atom. Its chemical symbol is Pa, its atomic weight 230.

PROTOCOL, a term of general application in diplomacy, with several meanings. For example, it is the minutes or proceedings of INTERNATIONAL CONFERENCES. It sometimes designates an agreement, less formal than a treaty (see TREATIES), which sets forth the principles relating to the execution of an ordinary treaty, its interpretation or enforcement. It may also indicate an agreement which espouses common and general principles of the parties, which are in the form of a declaration, and which are intended to be less binding than a treaty. The protocol also means the rules, forms and procedure to be observed by

diplomatic representatives in all their international acts, and especially written and oral intercourse.

C. E. MA.

PROTON. See MATTER.

PROTOPLASM, the living substance or physical basis of life constituting the soft parts of the cells of animals and plants. Cells are small, usually microscopic, parcels of this living fluid, each with a central core, or nucleus, the chief components of which are jelly-like rodlets called chromosomes, or color-bodies, from their avidity for certain (basic) stains. The reaction to dyes of the protoplasm surrounding the nucleus, or cytoplasm, indicates that it is neutral or alkaline, whereas the chromosomes are charged with nucleic acid. An essential feature of life is the give and take between the acid chromosomes and the enveloping cytoplasm. The former, by virtue of their constituent substances, the hereditary particles, or genes, direct the development of the cells and hence give shape, in some little understood way, to the growing organism.

Protoplasm is a colorless, or grayish, viscous colloid. In active condition, it is an emulsion containing exceedingly fine droplets of a watery cell sap suspended in a more viscous fluid, hyaloplasm. When protoplasm is solidified by the application of an acid or other fixing fluid, the hyaloplasm contains fibers called linin, forming a network covered with granules. A similar network within the nucleus suspends granular particles of chromatin, or, when the cell proceeds to divide, the rod-shaped chromosomes.

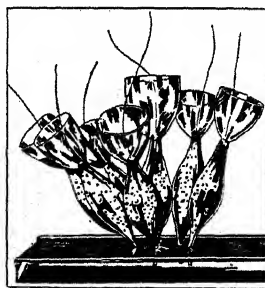
Cold and drought expel water from protoplasm, e.g., in spores, seeds or eggs, solidify it and make it dormant, but, its nucleus-cytoplasm organization remaining intact, it is ready, when spring comes or rains appear, to imbibe water and awaken into activity.

Except in winter or during drought, the cells composing protoplasm are in constant activity. The term resting cell, meaning that the nucleus is covered with a spherical membrane, as most cells are except when dividing, is a misnomer.

J. H. G.

PROTOZOA, the name for the subkingdom of animals made up of creatures composed of a single cell. There are five classes of protozoans. The most familiar are Flagellates like Euglena, Volvox and trypanosomes; Rhizopoda, such as amoeba, foraminiferans and radiolarians; and Infusoria (*Ciliophora*) like Paramecium, Vorticella and Stentor. The members of the two "sporozoan" classes (*Telosporidia* and *Neosporidia*) are all parasites.

Free living protozoans are found in fresh and salt water, and in damp earth and moss. Internal parasitic forms live in the bodies of all classes of animals.



COURTESY AMER. MUS. OF NATL. HISTORY

MODEL OF A FLAGELLATE PROTOZOAN

while a few live in plants. A limited number of species are external parasites on aquatic animals.

Among the Protozoa we find organisms of varying degrees of complexity. Such simple forms as amoeba demonstrate animal life reduced to its most elemental expression. Other protozoans have leaf green (chlorophyll) in their bodies, and feed like green plants. They are consequently on the borderline between the animal and vegetable kingdoms. Protozoans may either be solitary, or live together in colonies. In some colonies each cell functions as a complete individual, while in others differentiation takes place between the cells, so that only certain ones may reproduce. Thus a condition approximating that found in many-celled animals is reached by the most complex colonies. It is well to point out, however, that even in such colonies the cells never form tissues, and that all the cells not concerned in reproduction are alike.

As protozoans are not necessarily any more closely related to one another than man is to a lobster, it is only to be expected that they vary greatly in bodily form, in habits of life and in food supply. Apart from their unicellular organization it may be said that they have in common only the essentials of animal life. Most species are of microscopic size, but one foraminiferan (*Nummulites*) is as large as a quarter dollar. Some forms are enclosed in shells, or thickish cell walls, others are quite naked. Many familiar species are globular, trumpet or bell-shaped, oblong or formed like cigars, and are provided with ship-like flagella or hair-like cilia which serve as propellers or oars; others, again, like *Amoeba proteus*, may almost be called shapeless, as they constantly change their form, and move by pouring their fluid bodies along.

Like all living cells, whether plant or animal, protozoans always contain a cell-nucleus, surrounded by the cell-body (cytoplasm). There may be more than one nucleus, as among Infusorians. Some forms, like Stentor, can be cut into two parts, one of which contains the nucleus, while the other is only cytoplasm. The first part will regenerate the whole animal, but the second part, although it may move about for awhile, is unable to feed or reproduce, and shortly dies.

Some protozoans feed simply by surrounding their prey with their body substance; some, saprophytes and parasites, absorb liquid food through their body walls; some are provided with mouths, and some feed like green plants. They grow, and reproduce their kind by simple fission, by budding or by multiple division, and in a few cases they reproduce sexually.

In the economy of Nature Protozoa are important as food for other animals. Chalk and sandstone are formed largely of the shells of foraminiferans and radiolarians. Most of the parasitic species are harmless, and some are positively beneficial to the host (see SYMBIOSIS). Certain parasites, like many trypanosomes and the malarial organism, cause dangerous diseases to man and other animals. See also AMOEBA; ANIMAL; BIOLOGY; INFUSORIANS; MALARIAL PARASITE;

PARAMECIUM, STENTOR; TRYPANOSOMES; VORTICELLA; ZOOLOGY. A. I. W.

PROUDHON, PIERRE JOSEPH (1809-65), French Socialist writer, was born at Besançon, July 15, 1809. In 1840 he published *Qu'est-ce que la Propriété?* subsequently answering his question of a definition of property with a second volume, *C'est le vol* (it is theft). By reason of his *Systèmes des contradictions économiques*, and *De la Création de l'ordre dans l'humanité* he came to occupy an important position in French Socialism. During the revolution of 1848 he exerted considerable influence upon political movements as editor successively of three daily journals. He died at Passy, near Paris, Jan. 16, 1865.

PROUST, LOUIS JOSEPH (1754-1826), French chemist, was born at Angers on Sept. 26, 1754. After spending some time as the chief apothecary to the Salpêtrière in Paris, he went to Spain, and taught at Segovia, Salamanca, finally being called to Madrid by Charles IV. In 1806 he returned to France and remained there when in 1808 his royal patron died, and he lost his position. One of the founders of the wet method of chemical analysis, he upheld, and proved, in the face of the most vigorous scientific opposition, including that of C. L. BERTHOLLET, that the composition of a chemical compound is constant—the fundamental principle for all of later chemistry. His work on sugars drew the attention of Napoleon, who tried in vain to make him start a sugar factory during the continental blockade by the British. He was elected to the Academy in 1816, and died at Angers, July 5, 1826.

PROUST, MARCEL (1871-1922), French novelist, was born in Paris, July 10, 1871. For some time he was associated with the *Revue Blanche*, but social affairs occupied much of his energy. He found time, however, to translate John Ruskin into French. In 1902 his health became so bad that he was forced to lead a rigidly secluded life; he suffered up to the time of his death from asthma. With practically unlimited time at his disposal, and enjoying private means, Proust started to write long, extremely detailed novels of the social life of Paris. In 1913 was begun the publication of 15 volumes under the title of *A la Recherche du Temps Perdu* (see REMEMBRANCE OF THINGS PAST). The first part was called *Du Côté de Chez Swann* and the second, *L'Ombre des Jeunes Filles en Fleur*. Proust now became widely discussed and in 1918 he was awarded the Goncourt Prize. Next came *Le Côté de Guermantes* and in 1921, *Sodome et Gomorrhe*, the remaining novels were published after his death. The strange conditions under which Proust wrote, his double windows, his fear of draughts and the complete invalidism only relinquished of an evening when he emerged to attend some social function, have been much discussed. Proust died in Paris, Nov. 18, 1922. His literary influence has increased steadily since his death.

PROVENÇAL LANGUAGE, a ROMANCE language formerly spoken in the southern half of France and still represented by numerous patois which Mis-

TRAL and other poets have attempted to revive, with some literary success.

From its word for "yes" it is frequently termed the *langue d'oc* as FRENCH is called the *langue d'oïl* (Modern French *oui*) and ITALIAN the *lingua de sì*. It was employed by the troubadours early in the 10th and 11th centuries, in which form it is quite different from the modern dialects. In morphology it resembles Old French, but in phonology diphthongizes a vowel only before a palatal, Latin *nocte*^m = Provençal *nuech*, French *nuit*, "night," but Latin *bene* = Provençal *ben*, French *bien*, "well." H. F. M.

BIBLIOGRAPHY.—J. Anglade, *Grammaire de l'ancien provençal*, 1921, O. Schultz-Gora, *Altprovenzalisches Elementarbuch*, 4th ed., 1925.

PROVENÇAL LITERATURE owes its existence to the fact that from medieval times to the present day the natives of that region of France formerly known as Provence have kept alive an entirely distinct branch of the Latin speech. At the present time this dialect is not spoken solely by the peasantry, as is the case with several European dialects, and it is understood, if not actually used as a medium of speech, by natives who have a claim to be considered highly cultivated.

The Provençal language, which at one time promised to become the dominant language of the whole of France, is thought to be the oldest of the Latin idioms. During the period of its greatest glory in the 12th century, it differed as much from French as French did from Italian, and spread far beyond the confines of Provence, extending into northern Spain and beyond the Alps into Italian territory. But towards the end of the 13th century the language of northern France gained strength and spread southward, gradually encroaching on the stronghold of the Provençal idiom and finally reducing it from its high place as a literary language to a dialect. The earliest compositions in Provençal were epic romances on historical subjects, but few of them are now extant. During the 12th century the idiom was made a literary language by the troubadours who invariably sang of love and chivalry. As these are ideal subjects for lyric poetry one may find here the explanation for the fact that Provençal has from first to last used poetry as its chief vehicle. To such an extent did the troubadours popularize the appreciation of poetry that schools of poetry were founded in most of the Provençal towns, with professors who purported to be able to teach it. In this period—the last part of the 12th and the first part of the 13th centuries—the troubadours and Provençal poetry were at their best. Some troubadours were so accomplished that they not only composed the poems and sang them but were also able to play the accompaniments to their songs. When voice and musical gifts were wanting, the poets were accompanied in their wanderings from court to court and from château to château by minstrels who were known in France as *jongleurs*.

The characteristic features of Provençal poetry was its complicated versification and its system of rhyme

and syllabic accent. There can be little doubt that the exaggerated concern for the purely technical aspect of poetry led Provençal poets into an artificiality of manner and a monotony of tone and subject which might not have been so evident had more stress been laid on natural feeling than on extreme elaboration of versification.

At the end of the 13th century the troubadours of Provence were in full decline. The chief cause for this was the war against the ALBIGENSES, coupled with the increasing domination of the French language. The ravages of the war scattered them while the encroachments of the French language gradually made their idiom less acceptable. In 1525 the Provençal language had fallen into sufficient disfavor to warrant the Pope issuing a bull in which he alluded to it as an "heretical" language and forbade its use. But by this time it had already ceased to be employed as a literary language. Nevertheless, a society was formed not long afterward in Toulouse, with the object of reviving the former popularity of Provençal poetry. This society continued to exist for centuries, and its branches spread throughout the south of France and even into Spain. It was not successful, however, in fully achieving the object in view. One is not astonished to find, therefore, that the age of Provençal prose at last set in with the fall of the troubadours and their songs of love and chivalry. The names on their roll call numbered about 400, and included a handful of women poets whose productions were far inferior to those of their male colleagues.

This prose literature, as has been said, cannot be classed with the Provençal poetry in literary importance. It comprised historical, political and judicial material, but had so little vitality that by the 16th century it had produced nothing worthy of serious attention. During the 19th century, however, the old poetical powers of the Provençal people burst into renewed activity, after having been dormant five hundred years. The pioneer in this revival was Jacques Jasmin, and another native named Roumanille founded an organization known as the Society of the *Felibres*, whose object was to preserve the Provençal language and traditions. The famous Nobel prizewinner, FREDERIC MISTRAL, is the chief Provençal poet of recent times.

BIBLIOGRAPHY.—A. de Closset, *Histoire de la langue et de la littérature provençales*, 1845; J.-B. Gaut, *Étude sur la littérature et la poésie provençales*, 1867; Antonio Restori, *Histoire de la littérature provençale*, 1894.

PROVERB, a short saying embodying some general truth or moral precept which has gained permanence and currency in common speech. An impersonal observation on life, couched in a few telling words, made more effective perhaps by rhyme, rhythm, alliteration or rhythmic balance, the proverb is common to all races and nationalities. Many European proverbs, of which Spain has the greatest number, originated in the East and were preserved by Hebrew, Greek and Roman authors, the Crusaders and the Spanish Moors. Many American proverbs

such as "Honesty is the best policy," "A small leak will sink a great ship," etc., were published in *POOR RICHARD'S ALMANAC*, by Benjamin Franklin.

PROVERBS, BOOK OF, in the Old Testament, was for many centuries ascribed to Solomon, but it is by no means certain that he wrote any part. Many of the proverbs are definitely credited to others in the book itself, to "the men of Hezekiah," to Agur and to Lemuel. All of them possess a style and form common to Oriental literature, which is fond of enshrining the wisdom of the sages in aphorisms. This collection shows the fruit of contact with nations beyond the frontiers of Israel, yet possesses the rich ethics of the national spirit. Many modern scholars tend to ascribe the final work to writers in the 4th and 3rd centuries B.C. Remembering that "a proverb takes a long time to make," it is quite irrelevant to date the book to any century. These reflect the good sense and wisdom of many ages.

PROVIDENCE, the capital and chief city of Rhode Island, the second largest city of New England, and the county seat of Providence Co. It is situated at the head of Narragansett Bay, about 44 mi. southwest of Boston. The city has a fine harbor, with direct steamer service to New York, Philadelphia, Baltimore, Norfolk and Mediterranean ports. The New Haven Railroad, bus and truck lines and several airports in and near the city, afford additional transportation.

Providence is a substantially built residential city, with fine parks and public buildings, including an imposing civic center. It is the seat of **BROWN UNIVERSITY**, chartered in 1764, and other educational institutions.

While maintaining a heavy volume of coastwise shipping trade, Providence also does a substantial foreign trade. Imports are heavier than exports, with coal, oil and petroleum products the principal items. Essentially, however, it is an industrial city, with a diversified manufacturing output. It is an important center for the manufacture of jewelry, silverware, steel tools, textile machinery, cotton, woolen and silk goods. In 1929 the aggregate value of all manufactures was about \$240,000,000; the 439 wholesalers proper distributed \$148,276,914 worth of merchandise, with cotton goods, chemicals, jewelry and optical goods and sea foods as the principal items; the 4,035 retail stores, whose sales aggregated \$172,716,868 gave full-time employment to 15,965 people.

After being banished from the Massachusetts Bay Colony, **ROGER WILLIAMS** founded Providence in 1636. It was incorporated as a town by the colonial assembly in 1649, and chartered as a city in 1832. The city still operates under the original charter of 1832, with several amendments, providing for a mayor and council form of government. Pop. 1920, 237,595; 1930, 252,981.

PROVINCE, in ancient Rome, a conquered territory outside Italy ruled arbitrarily by a Roman governor; an important unit of administration in Spain, Italy, Prussia and other European countries. In Can-

ada it corresponds to state in the United States. Ecclesiastically, a province is the territory presided over by an archbishop.

PROVINCETOWN, a town in Barnstable Co., eastern Massachusetts, a port of entry, situated at the extreme north end of Cape Cod, about 55 mi. southeast of Boston. The New Haven Railroad and steamboats to Boston afford transportation. Provincetown is a popular summer resort, and its miles of beaches, with their sand dunes and marine views, make it an artists' rendezvous. Although its fisheries remain the most important industry, manufactures include cod liver oil, hooked rugs, ship models and barrels. Provincetown was the first landing place of the Pilgrims in 1620, and here they drew up their famous Compact and elected John Carver first governor of the colony, before proceeding to Plymouth. Pop. 1920, 4,246, 1930, 3,808.

PROVO, a city in north central Utah, the county seat of Utah Co., situated on Provo River near Utah Lake, 48 mi. southeast of Salt Lake City. It is served by bus lines and three railroads. Irrigation has created a rich land in the midst of a desert, and the city is surrounded by grain fields and fruit and vegetable farms. Iron and other minerals are found in the vicinity. The city has large steel and woolen mills. In 1929 the manufactures amounted approximately to \$2,000,000; the retail trade reached a total of \$7,820,533. It is the seat of Brigham Young University. The Mormons came here in 1849; Provo was chartered in 1851. Pop. 1920, 10,303; 1930, 14,766.

PROVOST COURT, a military tribunal established under martial rule or military government, to administer justice and aid in the maintenance of order, replacing or supplementing the ordinary courts of the territory. In practice provost courts are inferior to military commissions in jurisdiction.

BIBLIOGRAPHY—U.S. Army, *Manual for Courts-Martial*; Winthrop's *Military Law and Precedents*.

PROVOST GUARD, a military police force organized and employed by the commanding officer of a large body of troops to aid in the maintenance of good order among soldiers outside of the interior guard lines. Such a force habitually cooperates with the local authorities.

PROVOST MARSHAL, the commander of a large body of troops usually details an officer to perform certain specified duties relating to police and discipline. The officer so detailed commands the Provost Guard or military police and performs such other duties, not belonging to some other branch of the service, as may be developed upon him by his commander.

BIBLIOGRAPHY.—Winthrop's *Military Law and Precedents*; *Manual of Military Law*, The War Office, London.

PROVOST MARSHAL GENERAL, an officer charged with the supervision and general direction of the military police or Provost Guard of a large command. In 1917 the President detailed an officer as Provost Marshal General of the United States to supervise the execution of that portion of the Selective

Service Act of May 18, 1917, which pertained to the selection of personnel from the civil population in order to transform the military and naval establishments of the country from a peace footing to a war footing. *See also* SELECTIVE SERVICE. E. A. K.

PROXIMA CENTAURI, the nearest of all stars now known, is only a little over 4 light years distant. It appears as a star of the eleventh magnitude, red in color, and is actually more than 10,000 times fainter than the sun. It forms part of the system of ALPHA CENTAURI, although separated from it by a distance of 1.3 trillion miles (1,300,000,000,000) or one-quarter of a light year. Both Alpha and Proxima move very rapidly in the sky and both approach us at a speed of 14 miles per second. *See* STAR: *map*.

PRUNING, the methodical removal of tree, shrub and vine parts to strengthen those that remain, induce fruitfulness, or control the form of the plants so treated. It also includes training and various repair features practiced in tree surgery. In general, the underlying principles fall into two groups, reduction of struggle for existence among plant parts and modification of plant habit, especially as to development of branch or flower buds. The latter is necessary to fruit production on fruit-bearing plants.

Nature prunes, but her methods are crude and dangerous to her subjects. She destroys useless twigs and branches or those that cannot compete with more favorably placed ones; but she often leaves stumps whose decay menaces the life of the trees on which they occur. Man, in much of his practice, improves on nature because he removes branches before they become large, thus favoring the healing process. When he removes large ones he does so in such ways as to avoid risk of subsequent decay.

In general, ornamental trees and shrubs are pruned to remove undesired parts, to augment bloom, or to induce some desired form. Pruning of fruit trees is less influenced by these principles than by the considerations which follow. Reduction of competition among branches and twigs enhances the production of finer specimens; maintenance, but not over-stimulation, favors the bearing habit; renovation of neglected trees, vines and bushes is greatly aided by spraying, fertilizing and cultivation. Heavy pruning of the top, especially while dormant, stimulates production of new branches because root power is concentrated in the remaining top. Conversely, heavy pruning of roots tends to reduce branch production because of lessened sap supply. Trees that produce abundant wood tend to be unproductive but checking such growth tends to fruitfulness. Trees drastically pruned at two- or three-year intervals tend to produce branches but little or no fruit. Light annual pruning produces more satisfactory results.

Intelligent pruning for fruit presupposes knowledge of where flower buds are borne, apples and pears mainly on spurs or stubby twigs; peaches mainly on shoots of the previous season; cherries mostly toward the ends of nearly straight spurs; grapes and the bramble fruits on green shoots of the current season.

Ornamental shrubs fall naturally into two groups: those whose blossom buds form during the previous season and remain dormant over winter such as forsythia and Japanese quince; and those which in the spring develop green shoots that bear blossoms later, such as hydrangea and rose of Sharon. Any winter pruning of the former lessens the number of blossoms, but those of the second class may be increased both in number and size by winter or early spring pruning. The one safe rule to follow is to prune within two weeks after the flowers have faded. M. G. K.

PRURITUS, a term specifically applied to a functional disorder of the skin characterized by itching but without any noticeable changes in the skin structure.

The primary symptoms are those of itching, burning or tingling. Scratching and rubbing may produce inflammation. The symptoms may be present constantly or occur at intervals. Several regions of the skin surface may be involved. Exposure to heat or cold will generally start an attack.

The most common generalized variety is that occurring in advanced years, associated with dryness of the skin and defective elimination. Another common type is that in patients having some liver disorder and jaundice, or the accumulation of bile salts and pigments in the tissues.

In the localized forms, the genital regions and anus are the parts most often affected.

Winter itch and summer itch are peculiar recurrent types that develop at the beginning of winter and summer respectively and last throughout the season. Winter itch starts usually in November or December and lasts until April or May. The attacks occur most often at night when the individual is undressing or in the morning when he arises.

The most important factor producing pruritus is excessive irritability of the skin. The absorption of certain drugs, nervous and mental diseases, focal infection, jaundice and intestinal disorders are other predisposing causes.

Bath pruritus, a burning and itching which comes on immediately after bathing, is due to both the water and temperature change to which the skin is subjected. The majority of the patients have harsh, dry, irritable skin.

In the generalized types of pruritus, cure is sometimes difficult. In the localized types, relief usually can be secured. If possible, the exciting or contributing causes should be located and removed. The food should be simple, easily digested and nutritious. The individual should drink an abundance of water. Alcohol, tea, coffee and tobacco are likely to prove harmful. Various drugs are used. In anal and genital pruritus, x-ray and ultra-violet ray treatments may prove valuable. In generalized types, the patient should avoid frequent bathing, especially in soapy water. Bran, starch and alkaline baths are sometimes helpful. In winter itch, the application of a plain grease, such as cold cream, is soothing and comforting.

W. I. F.

PRUSSIA, a free state of Germany, the largest state of the country in area and population. It is situated in northern and central Germany extending from the eastern to the western frontiers of the Reich. East Prussia is separated from the main body by Danzig and the Polish Corridor, and Prussian Hohenzollern is in south Germany surrounded by Württemberg and Baden. Area 113,740 sq. mi. without the Saar district.

Surface Features. Most of Prussia is in the North German Plain, though some of the southerly provinces are wholly, or in part, in mountainous territory. There is much coal in the Ruhr district and also in Silesia, but much of the Silesian coal fields were ceded to Poland. There is also some iron ore and other minerals in Prussia. *See* GERMANY.

Prussia is drained by rivers flowing into the North Sea, and Hohenzollern drains into the Danube. The largest rivers are the Rhine, Ems, Weser, Elbe, Oder and Pregel. The Weichsel and the Memel rivers bound East Prussia on the west and on the east, respectively. Prussia's total water power is estimated at two million horsepower, of which 500,000 is utilized. The lakes are mainly in Schleswig-Holstein, Brandenburg, Pomerania and East Prussia.

Population. In 1925 the population was 38,175,989, excluding the Saar district and including Waldeck, incorporated with Prussia in 1929. The most thinly settled sections are the lowland ranges on the Baltic Sea and the Luneburg Heath; the most thickly settled are those near the large cities, the industrial and mining sections and the edge of the Central Mountains. Prussia has 29 cities with a population of more than 100,000.

Religion and Education. In 1925 there were 24,750,000 Protestants (64.9%), 11,900,000 Catholics (31.3%), 404,000 Jews (1.1%) and 969,000 others. The largest percentage of Catholics is in Hohenzollern (94.4%). Education in Prussia is compulsory, intensive and on a high level. Of the 23 universities in Germany, 23 are in Prussia, among them are those of Berlin, Breslau, Bonn, Göttingen and Halle. Of the same rank are the technical "high schools." Music is taught at various schools and museums, most of the older cities of prominence being cultural centers.

Industry. In 1925, 25.5% of the earning population was engaged in agriculture and forestry, 40.9% in industry and trades and 17.1% in commerce and transportation. Potatoes, beets, hay, rye, oats and wheat are the chief agricultural products. The iron, textile and chemical industries are the most important, and the total of industrial plants and shops of all sorts in 1925 was 981,689, employing 7,432,271 workers. Of the workers, 1,464,321 were engaged in commerce, the largest numbers being in the Rhine province and in Berlin, which, in 1920, became an independent administrative district.

Government. Prussia consists of 12 provinces, the city of Berlin and Hohenzollern, the latter belonging administratively to the Rhine province. The Landtag, or Lower House, consists of 450 deputies (1928)

elected by citizens of both sexes. The Staatsrat, or Upper House, of at least 79 members, is elected by the Landtag and appoints the other ministers.

On July 20, 1932, President Von Hindenburg removed the Cabinet Ministers and appointed Chancellor Von Papen as Federal Commissioner to govern Prussia.

The financial budget of the government for the year 1928 provided for receipts and expenditures of approximately \$1,107,870,000.

PRUSSIA, HISTORY OF. Prussia, the land of the heathen and Slavic *Borussii* or *Pruzzen*, was conquered between 1226 and 1283 by the Teutonic Knights, a German crusading Order recently returned from the Holy Land. Many of the defeated inhabitants were put to the sword, and the remainder baptized. The Knights strove to colonize the region with German and Dutch settlers; built cities and fortresses; established an Order seat at Marienburg, 1309, developed a smoothly functioning administrative system; reclaimed considerable areas of hitherto unused land, and engaged in a thriving commerce, particularly in grain, amber and wax. The golden age of the Order in Prussia was reached under Grandmaster Winrich von Kniprode, 1351-82, a saintly man, a scholar and an able administrator.

Over a period of many years it became customary for the Knights to make border raids into the lands of the neighboring Lithuanians on the pretext of converting these pagans to Christianity. The union of Lithuania and Poland in 1386 weakened the relative position of the Knights and in 1410 the Poles routed them in the Battle of Tannenberg, near Danzig. Thereafter the Order declined rapidly. By the Treaty of Thorn, 1466, West Prussia was ceded outright to Poland, and East Prussia became a fief of the Polish King. After some decades of submission to foreign control, the Knights elected as Grandmaster the Hohenzollern Prince, Albert of Brandenburg, in the hope that he might prove strong enough to regain freedom for them. Albert strove to accomplish this, but received little or no help from either the Germans in the Holy Roman Empire or the richer members of the Order. Finally, in 1525, he followed the example of his relative, the Elector of Brandenburg, and became a Lutheran. He then dissolved the Teutonic Order, converted Prussia into a lay duchy with himself as hereditary duke, and paid homage to the King of Poland as his suzerain.

In 1568 the Polish King gave his consent to a written compact between the Prussian and Brandenburg Hohenzollerns, whereby the two branches of the family agreed upon mutual inheritance rights. Upon the death of Duke Albert II in 1618, accordingly, Prussia passed into the possession of his son-in-law, the Elector John Sigismund of Brandenburg, who only four years earlier had also made good a claim to the Rhenish territory of Cleves with its dependencies of Mark and Ravensberg. *See* BRANDENBURG.

Brandenburg-Prussia a European Power. It remained for the grandson of John Sigismund, the Great Elector Frederick William (1640-88), to make

of Brandenburg-Prussia a European Power. When Frederick William came to power his possessions were in evil state as a result of the vicissitudes of the THIRTY YEARS' WAR, 1618-48. Much land had been laid waste, considerable property and wealth had been destroyed, and trade was at a low ebb. Moreover, Frederick William owed a dual allegiance for his possessions, to the empire for Brandenburg and Cleves, and to Poland for East Prussia. He therefore determined as rapidly as possible to unify his territories, restore order and prosperity, and gain increased international prestige. By skillful, if unscrupulous, diplomatic maneuverings during the remaining years of the Thirty Years' War, in the Swedish-Polish War of 1655-60, and in the Dutch War of Louis XIV, 1672-78, the Great Elector not only added to his possessions (Peace of Westphalia 1648) the three wealthy bishoprics of Halberstadt, Minden and Magdeburg, as well as the eastern part of Pomerania, but also secured East Prussia in full sovereignty and without further feudal obligations to Poland (Peace of Oliva, 1660), and made of Brandenburg-Prussia a leading Baltic and German Power.

The Great Elector also took care to consolidate his control by combining all of his territories into one administrative unit, by setting up at Berlin a single royal council to advise him on matters pertaining to the entire domain, and by establishing a regular postal service between the various parts of his realm. In addition, he improved the army, reorganized the financial system, fostered trade and commerce, built roads, drained marshes, built the Frederick William Canal joining the Oder and Spree rivers, and invited to Brandenburg the industrious Huguenots who left France after the revocation of the Edict of Nantes by Louis XIV, 1685. It remained for the next elector, Frederick, however, to secure the title of King for the Hohenzollerns.

This distinction Frederick attained at considerable expense and as a reward for lending aid to the Emperor Leopold I in the WAR OF THE SPANISH SUCCESSION, 1701-13. Since West Prussia still was owned by Poland, Leopold conferred upon Frederick the title, King *in* Prussia, 1701. By the PEACE OF UTRECHT, 1713, Frederick secured European recognition of his new title and also confirmation of an inherited claim to Neuchâtel in Switzerland. Upon his death the vain and extravagant Frederick I was succeeded by his son King Frederick William I, 1713-40.

Under King Frederick William I "money, military might and divine-right monarchy became the indispensable props of the Hohenzollern rule in Prussia." He distinguished himself for his absolutism, his economy, his establishment of an effective army, and his creation of a bureaucracy which soon became famous for its efficiency and honesty. During this reign industry, trade, elementary education and colonialism were furthered with great energy. Although the King had no flair for diplomacy, he added considerable reaches of land to his possessions through

minor conflicts within the Empire and with Sweden. In 1713 he acquired some territory along the Lower Rhine, and in 1720 he deprived Sweden of the island of Rugen, the province of Stralsund, and another piece of Pomerania. Upon the death of Frederick William, his son, Frederick II, 1740-86, ascended the throne.

Territorial Expansion. FREDERICK II, the Great, despite his literary, artistic and musical tastes, soon raised Prussia to the rank of a Great Power. His foreign policy was characterized by aggressiveness and great skill. In the very year of his accession to power he attacked the Habsburg Queen Maria Theresa in order to acquire the rich German province of Silesia. Although he achieved this end, in 1745 by the Treaty of Dresden, he had to engage in another military struggle—as one phase of the SEVEN YEARS' WAR, 1756-63—before this conquest was made permanent, by the Treaty of Hubertusburg, 1763. Nine years later Frederick joined Catherine II of Russia and Maria Theresa in the First Partition of Poland. Prussia's share of the spoils consisted of West Prussia except the cities of Danzig and Thorn. Thus Brandenburg and East Prussia came for the first time to be connected by Hohenzollern territory. Frederick next helped to frustrate an attempt of Emperor Joseph II to add Bavaria to the Habsburg patrimony, by participating in the War of the Bavarian Succession, 1778-79. Finally, in 1785, Frederick brought about an association of German princes called the *Fürstenbund* for the express purpose of preventing the further aggrandizement of Austria at the expense of other German lands. Upon Frederick's death in the following year, however, this league was dissolved. Frederick was succeeded by his nephew, Frederick William II, 1786-97.

Frederick William II was a pleasure loving but religious monarch, more interested in art and mistresses than in politics, and quite content to pattern his foreign policy after that of Austria. Thus he joined with Emperor Leopold II in issuing the Declaration of Pillnitz, 1791, a weakly worded warning to revolutionary France to restore law and order. But the French blithely disregarded this threat since they knew that both Austria and Prussia were fully preoccupied with the carving up of Poland. In the Second and Third Partitions of that ill-fated country, 1793 and 1795, Prussia acquired Danzig and Thorn, as well as the lower valley of the Vistula with the important cities of Posen and Warsaw. Although the size of Prussia was thus nearly doubled, the territorial additions were poor and inhabited by a non-German people who were not easily assimilated.

War With France. In Apr. 1792 the French Legislative Assembly declared war on both Prussia and Austria. The struggle dragged on for some years, and though the allies were soon joined by some other Powers, Prussia preferred, in 1795, to sign a separate peace at Basel. By the terms of this treaty, which decreased even further Frederick William's waning prestige, Prussia accorded France a free hand in the

territory to the west of the Rhine, reserving the right merely to compensate herself at the expense of other German states east of the Rhine in the event that her own Rhenish possessions were placed in jeopardy.

Under Prussia's next king, Frederick William III, 1797-1840, the outlook appeared no more bright. This ruler was religious and kindly, but timid and subservient to Austria. In 1806 the Prussians committed the blunder of attacking a superior French force under Napoleon at Jena, shortly after he had defeated an Austrian army. By the Treaty of Tilsit, 1807, Napoleon reduced Prussia's territory by half, limited her army to a force of 42,000 men, levied an indefinite indemnity upon her, and forced her to support a French army of occupation. The limit on the size of the military force as imposed by Napoleon was evaded by the replacement of each group of 42,000 men with a new contingent as soon as a stated minimum of training had been imparted. Thus Prussia was made ready to take a major part in the Wars of Liberation, 1813-15, which ended with Napoleon's downfall.

At the CONGRESS OF VIENNA, which now met to readjust the map of Europe, Prussia might have taken the lead in German affairs had she hearkened to the patent demand for German unification. But Frederick William III was not interested in so bold a step. He was content to regain for Prussia part of Poland, and to acquire in addition two-fifths of Saxony, extensive lands on both sides of the Rhine, and what was left of Swedish Pomerania. That Austria should occupy the leading position in the new Germanic Confederation which was formed at the Congress, seemed to him only natural. During the remainder of his long reign he was ever ready to defer to the superior wisdom of the Austrian chancellor Prince Metternich, who made it one of his chief tasks to retard the rising Liberal and Nationalist movements in Central Europe. One of the few decisive independent moves made by Prussia in these years was the formation of a ZOLLVEREIN, or customs union, between herself and 16 other German states, effective from Jan. 1, 1834. This step toward German economic unification was a significant forerunner of the later political unification under Prussian auspices.

From 1840-61 Prussia was ruled by FREDERICK WILLIAM IV, the "royal romanticist." He was a religious mystic and an obstinate though kindly man. The Liberals expected much in the way of political reform from him, and a few Liberal enactments actually were made. But the King was annoyed by the unrest which characterized the land during the '40s, and by the criticisms of the Liberals who were angered by his indecision. Thus it happened that although he called together a Prussian Landtag, or diet, in 1847, he refused to heed any of its demands for constitutionalism and unyieldingly clung to all his royal prerogatives.

Prussian Constitution. During the revolutionary days of 1848, however, the King became worried. He was frightened at the fervor displayed by the

populace, and by the violence. He finally consented to appoint a Liberal ministry and grant a Constitution. Such a document was issued in Dec. 1848, and definitively revised in 1850. In its final form the Prussian Constitution, which remained in effect until 1918, reaffirmed the divine right of the king, guaranteed the rights and liberties of the citizens, provided for a ministry responsible to the king, made the sovereign head of the army, church, and civil service, set up an almost exclusively appointed upper house (*Herrenhaus*), and established universal manhood suffrage for a lower body (*Abgeordnetenhaus*). Elections to this lower house were both indirect and undemocratic. The voters were divided into three groups according to the amount of taxes they paid, and each group was permitted to elect an equal number of representatives to the house. Thus the numerically small, but wealthy, group had as many delegates in Parliament as the numerically much larger, but financially poorer, group.

In Apr. 1849, meanwhile, Frederick William had refused the offer of a German Emperor's crown from the FRANKFORT ASSEMBLY, a Constitutional Congress elected by order of the Diet of the Germanic Confederation. The King had no desire to accept a "crown of shame" from his inferiors, nor did he care to antagonize Austria and Russia by unduly increasing his own power and prestige. In his later years Frederick William showed increasing signs of mental illness, and in 1858 his brother William became regent. Three years later the regent became King WILLIAM I. William was conservative, and an able man. He was determined to rule in his own way, and he soon came into conflict with his Parliament especially over the question of strengthening the army. William was prepared to abdicate rather than permit the legislature to block his attempted military improvements, but in 1862, as a last move to win his point, he called OTTO VON BISMARCK to become minister-president and to "tame" Parliament. This feat Bismarck accomplished through sheer force of will and determination. Then he proceeded to plan for the unification of the Germanies. In accordance with his scheme he built up Prussian economic, military and financial power, and greatly increased the prestige and power of the King. In the field of international politics he maneuvered events so skillfully that all three of the Powers which he found it necessary to fight (Denmark in 1864, Austria in 1866, and France in 1870-71), were diplomatically isolated at the time of conflict. And the Prussian military machine accomplished the rest. See GERMAN.

North German Confederation. After the defeat of Austria in 1866 the Germanic Confederation was dissolved, Austria was ousted from German affairs, and a new NORTH GERMAN CONFEDERATION, under the presidency of Prussia, set up, 1867-71. Four years later, after the defeat of France, William I of Prussia also became William I, German Emperor, Jan. 18, 1871, his new rank being proclaimed in the

Hall of Mirrors at Versailles. The Constitution of the new Empire established Prussia as the leading state in the federation. Prussia alone was practically able to veto any Constitutional amendment, and in addition enjoyed a number of special prerogatives denied to the smaller states. But this was only natural since Prussia comprised two-thirds the land area and two-thirds the population of the Empire. Upon William's death in 1888 he was succeeded as King of Prussia and German Emperor by his son FREDERICK III. The latter died within a few months and was in turn succeeded by his son WILLIAM II, 1888-1918.

A Republic. In 1918, after the defeat of Germany in the WORLD WAR and after the German Revolution, William II abdicated both as Emperor and as King. Prussia, which of all German states, had lost most heavily under the political, territorial and economic terms of the VERSAILLES TREATY, 1919, adopted a republican Constitution and sent a large delegation to the German Constitutional Assembly at Weimar, 1919. The Constitution for the new German *Reich* as drawn up at Weimar greatly reduced the relative influence of Prussia in the federation, particularly by providing that no one member state might have more than two-fifths the seats in the upper house of the national legislature. Nevertheless, by virtue of its size and population Prussia remains the dominant factor in German national life. W. C. L.

BIBLIOGRAPHY.—W. H. Dawson, *The Evolution of Modern Germany*, 1914; J. A. R. Marriott, *The Evolution of Prussia*, 1915, H. L. McBain and L. Rogers, *The New Constitutions of Europe*, 1922, E. Diesel, *Germany and the Germans*, 1931.

PRUSSIAN, OLD, an extinct BALTIC language spoken in East and West Prussia until the second half of the 17th century in at least two dialects. Its literature consists of three Lutheran catechisms, two published in 1545 and the third in 1561, and of two vocabularies of the 14th or 15th and of the 16th century. The Baltic tribe of Jatwings also spoke a Prussian dialect of which practically no documents have survived.

BIBLIOGRAPHY—R. Trautmann, *Die altpreussischen Sprachdenkmäler*, 1910.

PRYOR, ROGER ATKINSON (1828-1919), American lawyer and journalist, was born in Dinwiddie Co., Va., July 19, 1828. He graduated from Hampden Sidney College in 1845, and from the University of Virginia in 1848. In 1854 he went to Washington to edit the *Union*. In 1858-60 he served in Congress, and when Virginia seceded he became a member of the Confederate Congress. As a colonel of a Virginia regiment, he distinguished himself, and became brigadier general, but a quarrel with Jefferson Davis caused his resignation in 1863. He re-entered the service as a private in Fitzhugh Lee's cavalry and was captured in 1864. After the war he settled in New York, became a lawyer, and subsequently a judge. He died in New York City, Mar. 14, 1919.

PRZEMYSL, a city with the oldest castle in Little Poland located 60 mi. west of Lemberg on the River

San in the Polish voievodship of Lemberg. The origin of the city dates from the 7th century. It is the seat of a Roman and a Greek Catholic bishop, three monasteries, a theological seminary and advanced schools. Beside railroad shops Przemyśl has manufactures of wood and leather, earthenwares and glue. Being a fortress in East Galicia it was besieged twice in the World War and finally taken by the Russian army after it had been reduced to starvation. Pop. 1921, 47,958.

PSALMS, BOOK OF, in the heart of the Old Testament, contains 150 hymns and songs for both personal and liturgical use, and as such has been much esteemed both in the Jewish and Christian services. As the psalms appear in the Revised version of the Bible, they follow the early Jewish division into five groups: (1) 1 to 41; (2) 42 to 72; (3) 73 to 89; (4) 90 to 106; and (5) 107 to 150. From internal evidence they appear to cover a period from the days of King David to the Babylonian captivity. Because of the tradition that David had musical skill, many of the psalms were early attributed to him, and in common speech until recent years, the entire book was often referred to as the Psalms of David. His authorship has, however, been a question since the earliest Christian centuries, and the post-exilic songs must certainly have come from another singer.

The chief interest in the Psalter, however, is in its inspirational quality. For more than 2,000 years its hymns and prayers have furnished the sects of three religions with aspiration, comfort and instruction. In it we read of the Shepherd who leads his flock in green pastures beside still waters; we find the sun described as "a bridegroom going forth from his chamber," and hear the *Miserere mei* and *De profundis* of humanity, "as the hart pants after the waterbrooks." On the other hand, when the soul has wanted expression for joy and praise, this same manual of devotion has supplied many a *Benedictus Dominus* and *Jubilate Deo* for the hour. It is significant that out of the nearly 150 actual citations from the Old Testament to be found in the New, 116 of them are from this book.

PSEUDO-MESSIAHS, JEWISH. From time to time in the course of Jewish history persons appeared claiming to be the long-awaited deliverer of Israel, the MESSIAH, the "anointed one," the bodily descendant of the royal house of David, who had come to redeem Israel from its bondage, to cast off the shackles of its oppression, and to usher in the glorious period of Israel's prosperity and greatness among the nations of the world. This Messiah, who, the people believed, might appear at any time, was generally considered as a military hero, a warlike leader and fighter, who would defeat Israel's oppressors in battle, regain possession of Palestine, restore the Temple at Jerusalem, and reestablish Israel's supremacy as the ruler of the world. His advent had been expected ever since the days of the later prophets and the destruction of the First Temple, ever since Israel had begun to be subjected to foreign domination. How-

ever, he had always, in every age and by every Jewish person, been conceived of purely as a human being, a lineal descendant of King David, the great military king of the early part of the 10th century B.C.

Most of these pseudo-Messiahs were adventurers and impostors who exploited the credulity and sufferings of the Jewish population for the purpose of self-aggrandizement or for that of acquiring wealth. One or two of them, however, as Bar Kochba and Solomon Molcho, appear to have been sincere in their belief that they were the Messiah, and the victims of their own religious convictions and delusions.

The greatest Jewish pseudo-Messiahs were DAVID REUBENI, SOLOMON MOLCHO, JACOB FRANK, and SAB-BATAI ZEVI. A. SH.

BIBLIOGRAPHY—J. H. Greenstone, *The Messiah Idea in Jewish History*, 1906, Graetz, *History of the Jews*, 1926

PSEUDO-PSYCHOLOGY, a general term referring to false or unscientific systems of interpretation of the sources and nature of mental phenomena, particularly in reading character and allied pursuits. The broader term would be pseudo-science, to include such systems as ALCHEMY; yet many of these encroach upon the domain of psychology. The terms METAPSYCHOLOGY and PARAPSYCHOLOGY have been proposed for allied conceptions.

PSILOPHYTALES, a recently recognized fossil class composed of early Devonian mosslike plants displaying a rudimentary vascular system. In 1913 silicified peatbeds at Rhynie, Scotland, yielded three new genera of extremely simple little plants, rootless, and in some cases wholly leafless, which possess peculiar interest as exemplifying the earliest known stages in the adaptation of algæ to life on land. In *Rhynia*, the lack of leaves is compensated for by breathing pores developed in the epidermis of the low, erect stems. The more advanced *ASTEROXYLON* is clothed with scalelike leaves. The class is named for the related, though long neglected, *Psilophyton princeps*, described by Dawson in 1859.

PSITTACOSIS, a disease occurring in birds of the parrot family showing signs of cold and general drooping, which can be transmitted to human beings through handling the sick birds, with often fatal results. The disease first came to notice by its occurrence in Switzerland in 1879, a short time after the arrival of a consignment of parrots from the tropics. Since then epidemics have appeared in other countries, as France and England and more recently in the United States.

The disease is due to infection with the *Bacillus psittacosis* which was isolated in 1893. In human beings the disease begins with headache and fever, symptoms of influenza or pneumonia quickly developing, accompanied by abdominal disturbances. The course of the disease is from five to six weeks and may end fatally.

Treatment is largely symptomatic as no specific remedy has been found. A serum has been developed from cases of psittacosis but has not been very successful in the treatment of the disease.

PSKOV, the administrative center of the Pskov district in the Leningrad Region of the R.S.F.S.R. in northwestern Russia. Near the Latvian border and Lake Pskov, it is situated on the Velikaya River. It has excellent rail connections. Founded in the 10th century, Pskov became the prosperous capital of an independent principality. It developed as a trading point and was annexed to Muscovy in 1510. During the period from the 12th to the 16th century, the Kremlin of Pskov was built and underwent many changes. Leather, lumber and machinery are Pskov's leading products. Pop. 1926, 43,857.

PSOCOPTERA. See CORRODENTIA.

PSORIASIS, a skin condition in which there appear on the skin, round, scaling patches. They are most abundant on the backs of the arms, over the knees and other bony prominences, including the scalp. The patches vary in size. If the scales are removed, bleeding points are visible. There are apparently no unfavorable effects on the general health. The skin eruption may be cleared up, but tends to reappear. The cause for the disorder is not known.

PSYCHE, in Greek mythology, the daughter of a king, a lovely maiden of whose beauty APHRODITE was jealous. EROS loved Psyche and carried her to a fairy palace, where he visited her every night, but told her she must not look at his face. At last in curiosity she held a lamp over him while he slept, and he came no more. ZEUS, pitying her desolation, gave her immortality that she might wed her lover. Psyche is the personification of the soul and is represented with the wings of a butterfly.

PSYCHIATRY, a term meaning literally "soul healing," is that branch of medicine which deals with disorders of the mind. By many it is thought to deal only with so-called insanity, in which the whole picture is dominated by the mental disturbance, the associated bodily symptoms being in the background. However, in a wider sense, psychiatry deals with every form of mind disorder, with all types of mental reaction in response to disturbing physical or psychic influences. It, therefore, comes into close contact with psychology, particularly abnormal psychology, with neurology, and with every other department of medicine, as there is a mental side to every case of disease. It also merges with mental hygiene: in fact, preventive measures are so all important that mental hygiene really is part of psychiatry.

In many ways psychiatry is the least advanced of medical sciences. Superstition, in the form of ideas of demoniacal possession and obscure metaphysical speculation, dominated the views of mental disorders for centuries after more rational conceptions of bodily disease had come to prevail. The new views of the rights of man fostered by the French Revolution, enabled the French physician, Philippe Pinel, to get permission from the republican government to remove the chains and shackles of the insane, and from that time these unfortunates began to be treated as sick people and not as harboring the devil. William Tuke and later John Conolly in England and William

Griesinger in Germany were prominent in furthering humane care of the insane and a scientific status for psychiatry. In America, the celebrated Philadelphia physician, Benjamin Rush, published a book on insanity in 1812.

The recognition of general paresis as a disease entity by Bayle, in 1822, was an important forward step, largely because it then became understood that different mental states—depressions, manias, confusions and dementia—may be present in this same disease. It is noteworthy that this recognition of paresis as an entity took place long before it became known that it is always caused by syphilis.

In the last quarter of the nineteenth century the progress in psychiatry can be measured by the successive editions of the textbook of the German professor of psychiatry, Emil Kraepelin. He was the first to establish a classification of mental disease based upon the whole course and outcome. Before his time, a superficial classification based upon the appearance and mood of the patient had been in use.

Mania was designated as a condition of excitement and hilarity, melancholia one of sadness, dementia one of dullness, paranoia a state in which delusions and hallucinations dominated the patient. Chaos had resulted, as many patients went through different phases, so all of these terms might fit the case of a single patient at different times.

Kraepelin's master stroke was to create the term manic-depressive insanity for cases with recurrent attacks of mania or depression or both, and in which mental weakness (dementia) rarely set in, the patient being normal between the attacks of emotional disturbance. The other important contribution by Kraepelin was the grouping together as "DEMENTIA PRAECOX" of a huge mass of cases with varied mental pictures in the early stages, but having in common the termination in a state of chronic mental deterioration (dementia).

However, even Kraepelin's contributions did not bring the understanding of mental disease forward to a stage comparable to that reached in the case of purely bodily diseases. With the exception of the forms of mental disorder dependent upon organic diseases, the great discoveries in bacteriology, pathology and chemistry which have revolutionized general medicine have done little for psychiatry. New avenues of approach are needed. Some advance in deeper understanding of mental mechanism must be credited to the psycho-analytic school of Freud and his pupils, some of whom, like Jung and Adler, have created somewhat divergent psychologic schools of their own.

On account of the important legal relations of insanity in connection with criminal and civil responsibility, *legal* or *forensic* psychiatry has become an important meeting ground of medicine, psychology, law and sociology.

P. BA.

PSYCHIC, a term which generally refers to the mental or psychic aspect of the processes studied in psychology; in a special sense it has come to mean endowed with special powers transcending the ordi-

nary use of the senses. The medium in **SPIRITUALISM** was called a psychic, as would be also those claiming telepathic or related abilities. Similarly **PSYCHICAL RESEARCH** is the name given to the examination of such claims and of the phenomena presented in evidence.

PSYCHICAL RESEARCH, a term established by the foundation of the Society for Psychical Research at London in 1882, proposing to investigate the entire realm of alleged supernormal happenings, including particularly the power of especially endowed individuals to transcend the recognized avenues of sense, and the phenomena which spiritualism adopts to explain the communications with the dead. The convenience of an inclusive name for these outlying and questioned phenomena of the mind justifies the term, while none the less they belong to one phase of psychology.

Basic to the program of investigation is telepathy, which considers the possibility of communication of mind with mind apart from the senses. The evidence may be experimental or casual observation, premonitions or dreams. While few psychologists accept telepathy, the evidence is formidable and is considered in the article on **TELEPATHY**.

The program of psychical research includes the investigation of spiritualistic phenomena: the alleged powers of spirits to communicate through mediums, to present materialized forms, to move objects without contact, to appear in spirit photographs and so on. This body of evidence is reviewed in the article **SPIRITUALISM**. The physical, including **ECTOPLASM**, and the psychic phenomena of spiritualism are distinct. The latter involve revelation by the medium of the private affairs of the sitter; they may be revealed in a state of **TRANCE** or by **AUTOMATIC WRITING**.

PREMONITIONS and presentiments and the prevalence of **HALLUCINATIONS**, likewise with a prophetic or truth telling value, have been investigated. Also the power to reconstruct the past by getting into touch with the scenes of action, such as incidents in the life of Marie Antoinette at Versailles or even discovering archaeological ruins, as at Glastonbury, by communication through script emanating from a medieval monk through a medium, has been studied. These as well as such well-recognized phenomena as **CRYSTAL GAZING** indicate the overlapping of explanations, and the uncertain part that subconscious impressions and self-deception may play in the revelations.

Psychical research includes other problematical occurrences in the borderland of psychology, overlapping the same interests that have given rise to pseudosciences, to folk-lore beliefs and current superstitions. It recognizes the large factor of such misapprehension as well as the many and ingenious frauds perpetrated by sponsors of one belief and another and by mediums particularly. Important exposures have been made by psychical researchers. Many of them believe that there remains a residuum of evidence in favor of agencies not recognized by psychology. The sources

of belief in such occurrences, as well as the qualities of mediums or sensitives, mediumistic phenomena and dual personalities, are proper subjects for investigation, whatever the conclusions reached. Through the interest in psychical research, topics otherwise apt to be neglected have been naturalized in psychology. J. J.

PSYCHOANALYSIS, a method of studying the fundamental reasons for human behavior in terms of inward drives or urges and of the realities of external environmental situations. Psychoanalysis, therefore, is a method which can be used to learn why human beings do things; why they have preferences and prejudices, why they write stories, paint pictures, believe in lucky days or numbers, make mistakes, get into difficulties of money, of health, of happiness—in short, a method that can be used, with varying degrees of success, to learn the actual manner in which mankind's mental systems operate and bring about behavior.

Psychoanalysis may be used not only as a *method of study*; it also has great possibilities, by properly trained individuals, of *therapeutic application* in the treatment of numerous types of bodily ills, for all illnesses are of the "body," in the strict sense of the word. Furthermore, psychoanalysis stands for a group of *dynamic psychological conceptions* or ideas.

When men and women attempt to state their beliefs about behavior situations, they invariably tend to fool themselves, in slang terms they "pass the buck," in psychoanalytic terms they *rationalize*; that is, they like to make the explanations reasonable. Mankind universally indulges in phantasy thinking—autistic, that is, wish-fulfilling explanations for almost everything they do. Thus man's fancied beliefs that he always knew why he did this or that turn out to be largely fictional. An ancient theological figure spoke of "all mankind as liars." Psychoanalysis, while it recognizes that lying is a not unusual form that explanation of man's conduct takes, prefers to use the idea of *rationalization*, thereby meaning that what is manifest or open in man's reason is not always all that is there. What is in consciousness is being influenced by something deeper down in the individual, that is spoken of as *unconscious*—relative or absolute. Rationalization, therefore, is chiefly a compromise between what may be a real "unconscious" reason—*repressed*—and what may pass with the particular group that calls for explanation of the conduct in question.

Thus psychoanalysis would regard as essential the principle that a dynamic process of repression of unconscious urgings or drives is constantly operating in human behavior, in order to meet with real or fancied attitudes on the part of the physical or social surroundings.

Psychoanalytic psychology, called by Sigmund Freud **METAPSYCHOLOGY**, assumes that all human behavior operates through mental systems which may be divided roughly into three parts, termed by him the *Id*, the *Ego* and the *Super Ego*. The *Id* is that part

of man's mental systems which has accumulated experience with the world since life began on the globe and which is present in every part of the human body. It is a billion years old and is magnificently wise. Much of this "wisdom of the body" is absolutely unconscious. Such are the automatic activities that go on in the internal organs—kidney, liver, blood, spleen, etc.—and of which almost nothing is known in consciousness. This can be said to occupy the depths of the human being. It is the core of his personality, one might say, and is that part of himself which he shares with all other forms of life, plant as well as animal. Some biologists would use the word "*instincts*" to give a shorthand term for such inner drives or urges that are universal to all living matter.

Out of this primitive mass of experience, and chiefly apparent in man, a specialized part, the *Ego* arose. This part of the mental systems tests reality. It is conscious and uses words or signs or symbols of color, sound, etc. It is the conscious perceptive system and is an active agent in repression. By it is not meant the popular term *Ego*, the *self*.

If one should use an automobile metaphor to illustrate roughly these systems, one could compare the *Id* to the engine, the *Ego* to the steering gear operated by the driver. Man's engine, his *Id*, is always running, night and day. In the daytime the steering gear must always be in action; at night there is comparative rest for the *Ego*, but the mental systems still go on, as occasionally glimpsed in the dream.

When psychoanalysis began to study DREAMS, and also individuals with certain kinds of mild or severe sick behavior rationalized as "nervous," another important bit of the machinery needed stating. Wise people had known of it for centuries. In religion it was called "conscience"; in aesthetics, maybe "good taste"; in everyday life, "good manners," etc. In Freud's scheme this is the *Super Ego*, or *Ideal Ego*. It operates between the conscious perceptive system (the *Ego*) and the unconscious (the *Id*). In the rough automobile metaphor already used one can picture it as both hand brake and foot brake. It has been built up from precept and example, first from the parents and the nursery and then from the family to society. Some of it may even be very old (intuition). Its chief moulding comes from education. In the aphorism, "As the twig is bent the tree is inclined," we can see the work of the *Super Ego* chiefly.

Psychoanalysis sets itself the problem of analyzing the respective activities in these three parts of the mental systems in the explanation of any bit of social bodily activity, that is, activity of the entire person on the environment.

The entire drive comes from the *Id*, the primary instincts, often called self-preservation and race propagation, or what the poet Schiller called "Hunger" and "Love."

Psychoanalysis has learned and teaches that all of these factors in the mental systems have had to grow up, i.e., adapt. In infancy, both the *Ego* and *Super Ego* are very weak and badly organized and the *Id*

is all powerful. The child is a "little animal," as it is naively expressed. It lives in a phantasy world seeking only its primitive pleasures. It has tantrums, it sulks, or cries when not satisfied, or laughs and gurgles. It mostly sleeps. It soon begins to learn about reality through pain and then through precept and example. Thus the primitive titanic *Id*—neither good nor bad, but just the running engine—is guided by conscious experience and controlled by the *Ideal Ego* as an accessory brake, and the *Id* is unconsciously *repressed* or consciously *suppressed* to that degree that behavior is allowed in the particular group or situation: that is, becomes adaptive, successful and pleasure giving. In its highest form of social adaptation it becomes "*sublimation*."

So much for the dynamics, the how and why, without any details of the "what," the parts, that is, the organs of the body. Millions and millions of parts are involved, but as stated, they have had a billion years to learn their lessons; else man would not be here, the fittest of all animals thus far to survive. This is chiefly due to the increasing growth of one system of the body—the nervous system—and particularly one part of it, the central switchboard (the brain), where there are some several billion central stations with dial systems of which the American Telephone and Telegraph system is as simple a sample as the alphabet is to all the books in the world.

To attempt to say here anything about the parts, would involve much of what the chemist, the biologist, the anatomist and physiologist have learned. Some of this is necessary for the psychoanalyst, in order that he might get at the problems of non-adaptive conduct. Psychoanalysis has learned that the major, but not the only, drive in the human machine comes through the race propagation instinct. All other statements to the contrary are false. To the energy of this urge the term *libido* is applied. In accordance with this drive, man comes into being. The human being came to its present preëminent place in answer to its imperious urge. The hunger or "domination" instinct is insignificant in its tension compared to it. To satisfy stomach hunger alone is a comparatively easy task, but man does not live alone. Men and women are biological units, like locks and keys; they work together. Hence, when psychoanalysis began to analyze the *Id* as to its old, old patterns, it found it enormously complicated. The chemist has analyzed crude oil and finds he can evolve from it hundreds of thousands of different substances of which gasoline is only a mixture of a few. Similarly, the sex instinct has been found to be composed of a number of different impulses, which have evolved from childhood to manhood. The briefest summary of these are the infantile organic erotic stages, the adolescent self-love or narcissistic stages and the adult heterosexual stages, which in their highest sublimation forms evolve on through marriage, nest building, to a vast variety of creative productive activities.

The psychoanalytic method has shown that the

earliest infantile patterns have a certain form. To this form the term "Oedipus Complex" has been applied. In general, this means that, since male must find female in properly adaptive cravings in order that life shall go on, the infantile models show that the mother-father images are the respective aims of the boy-girl children. This unconscious infantile model, as such, is usually outgrown by 3 to 4 years of age. Those parts of it which linger behind in development (unconscious) show other patterns, out of which the "sense of guilt" and "castration anxiety" develop.

Other remnants (*fixations*) of infantile models, which require extra amounts of energy to repress, by both the developing *Ego* and *Super Ego* bring about definite *character traits* in different individuals according to the amount of energy involved in the mental system interchanges. This is but a brief characterization of the innumerable possibilities that take place in human engineering. Out of these character traits, the various kinds of behavior evolve and become more or less fixed or habitual.

The psychoanalyst is a trouble hunter who has developed a certain method of research to enable him to try to locate and to remedy certain human behavior difficulties due both to conflicts within and without the individual. He is a trained engineer in human behavior problems and only through such a training is he competent to use the psychoanalytic method. Inasmuch as he must work with the human machine, he should be one who knows such a machine, therefore primarily a physician. Further, since the most important part of the machine is that which organizes or integrates the entire machine, that is, the nervous system, he should be ideally a trained neuropsychiatrist. Furthermore, since man is inseparable from his human environment, from opinions, ideals, customs, etc., the psychoanalyst must needs make special studies of social customs, religions, literature, and the arts.

Psychoanalysis utilizes chiefly such unconscious material as is available: creative activities of the individual, poems, compositions. The *royal road to the unconscious is the dream life*, hence free associations of dream material are most often employed in psychoanalysis. The technical details of dream analysis are highly complicated and only *patient and analyst together* can analyse dreams. All other methods are nonsense and much rubbish is written and talked about dream analysis.

Psychoanalysis as a method, can be used to ascertain many fundamental difficulties, both of external behavior (conduct) and internal behavior (bodily disease); as a therapeutic procedure, however, to hope to remedy such difficulties, only well-trained individuals should be trusted and those licensed by the state to practise psychotherapy. PSYCHOTHERAPY is the most difficult and most important branch of medicine. Only well trained and qualified individuals should practise it. Were it not for the colossal credulity of mankind, itself a behavior disorder of a most malignant type, there would be less misery in the world.

S. E. J.

PSYCHOLOGICAL POINT OF VIEW

Psychoanalysis, in the special sense, refers to the technique devised by Dr. SIGMUND FREUD of Vienna, to detect the sources of bodily symptoms and mental difficulties in the psychoneuroses, and to direct their treatment. In the general sense, it refers to the entire resultant Freudian interpretation of the motives and mechanisms of the psychic life. The psychoanalytic movement includes the expansions and deviations of its followers, who remain psychoanalysts in interpretation and practice, but project the principles of their system in different terms. The two notable contesting schools are those of Jung, who calls his doctrine Analytical Psychology, and Adler, who gives it the name of Individual Psychology.

Clinical Aspects. As the interpretation originated in clinical experience, its exposition may begin there. In the original case, observed 1880-82 by Dr. Josef Breuer and published 1893-95, an hysterical young woman, under the stress of nursing her stricken father, developed an inability to move the right arm, a blurring of vision, a difficulty in drinking. These psycho-neurotic symptoms were relieved when their origins were traced respectively to the arm's falling asleep while the subject dozed at the bedside of her patient; to the tears in her eyes which interfered with her reading the time when, in alarm, she looked at her watch; and to aversion in childhood toward a governess who allowed her pet dog to drink from the family glass. The cardinal conclusions are (1) the symptoms are imposed by psychic, strongly emotionalized experience; (2) this acts through the submerged repressed route of the unconscious; (3) the impairment may be, in part, traced to childhood shocks; (4) while not distinct in this case, a sex problem dominates the process. The first becomes the psychogenic principle; the second, the subconscious; the third, childhood shock or fixation; the fourth of libido. The emotionally motivated mechanism of instinctive urges condition the entire set of psycho-neurotic incidents.

To supplement this case another may be cited in which a young girl exhibited shock of fright in reading a letter and found her left hand paralyzed. The analysis disclosed that she had herself written the letter and with her left hand to disguise the handwriting; it contained ardent expressions of pursuit as well as threat from an imaginary lover. The device was prompted by her disappointment that lovers had not appeared. The elements of sex and fantasy, in this case carried into action and imposing neurotic symptoms by the unconscious channels, are typically Freudian.

Analytical Procedures. To discover these hidden mechanisms, Freud at first used hypnosis, but soon abandoned it for the method of free associations and a talking cure, an informal, relaxed, but persistent following of clues and stimulating of memories that at first meet with resistance. However amplified or modified, that remains the essence of the psychoanalytic, or confessional, treatment. The principle of treatment anticipates that once these buried and pain-

ful memories are brought up to conscious level and their source understood, the impeding symptoms will disappear. In course of its development the psychoanalytic procedure, as well as the system of guiding principles which justify it and supply its foundations, becomes most complex, speculative and detailed.

Dream Analysis. At an early stage the use of dreams to furnish clues to the intricacies of the inner, or suppressed, life was effective. It indicated that in dreams, the conscious control or censorship was relaxed and permitted the repressed desires and unfulfilled wishes to elaborate incidents, episodes and sequences, dramatized and symbolical, which revealed the troubled plot. The dream as related gives the superficial patent content, but as psychoanalytically interpreted discloses the latent content, typically a repressed wish-fulfillment with a marked sexual content, induced by present conflicts or childhood shocks.

The analysis of a dream can hardly be given in summary; so much depends upon the details and their reference to the desires, suppressions and situations of the person concerned. Selecting from a longer dream the incident of a funeral procession yet with the incongruous appearance of dancers leading it, the interpretation proceeds upon the supposition that the actual death which induced the dream released a suppressed desire of the dreamer that she might now be able to wed a suitor who at one time hesitated between her and her sister. Yet the chief person concerned is not the actual one of her life drama, but a substituted one owing to similar traits of the two men involved. The suppressed wish with its sex determined tone, its dramatic disguise and symbolic meaning, all appear as typically Freudian in motivation. There are undoubtedly dreams quite completely conforming to this pattern, others with Freudian elements interspersed with others of a more obvious character, and doubtless still more dreams too fragmentary and simple to involve either. Dreams differ according as they follow the suppressed desires or the unacknowledged fears; hence the dream personality may be strongly like or decidedly different from the waking one. (*See DREAMS.*)

Lapses and Forgetting. Extending the principle still further toward the normal, Freud developed the thesis that lapses such as forgetting names or errands, losing objects, misspeaking or slips of the tongue, and mishandling or confusions and mistakes likewise betrayed concealing bits of motive. They were not wholly accidental but motivated or determined by miniature counterparts of the same mechanisms responsible for dream elaboration or the more serious psycho-neurotic impediments. Thus a speaker who said that the persons who understood their topics could be counted on one finger, meaning to say on the fingers of one hand, betrayed his opinion that he alone understood it. When Freud relates that he finds himself attempting to use the key of his house to open the door of the clinic, never the reverse, he concludes that this expresses a preference to be at home; when a bride-to-be forgets an appointment for trying on her bridal gown, it betrays an uncertainty whether the

marriage is desirable. The errand that we forget may be unpleasant, as also the letters delayed in answering. The principle of determinism in small affairs reinforces the order of motivation in serious ones.

The Unconscious. Throughout appears the principle of conflict between the consciously entertained, permitted, sanctioned, and the suppressed, subconsciously desired, or frustrated. Neurotic symptoms, dreams and lapses are all forms of breaking through these reserves, normal and abnormal, trivial or serious. Similarly, wit and the comic may be interpreted in terms of the unconscious, since its technique, though in lighter vein, yet with an element of criticism or sting or betrayal, follows the same psychoanalytical course.

When, at a later period, Freud presented his views in systematic form in *A General Introduction to Psychoanalysis* (Eng. translation, 1920) he adopted the logical, not the historical order, and considered first the lapses, or errors, as simple and wholly normal data; next the dreams, which though various are common experiences; and, last, the neuroses. Freud has frequently reconstructed his system, has built here and there upon an edifice that grew without an initial comprehensive design. The task of formulating the whole is thus left to his expositors and critics. The most adequate attempt to supply the lack is *The Structure and Meaning of Psychoanalysis* by Healy, Bronner and Bowers, 1930.

Psychoanalytical Psychology. The Freudian psychology, of which psychoanalysis is at once an application and the central doctrine, becomes an interpretation of the nuclear range of human behavior in its biopsychological setting. As such, its component factors, its structure and meaning, may be considered under the heads of (A) principles; (B) mechanisms; (C) applications. Earlier and later formulations must be considered.

The basic conceptions have already appeared: the subconscious, the emotional dominance, the critical importance of childhood experiences, the motivation or determinism, the sex intrusion, the repression, the conflict situations of one type or another. Of equally broad bearing is the distinction between the two orders of thinking, the one freer, earlier, following the lead of fantasy, which in turn expresses the wish or pleasure principle; and the other, the logical, acquired, controlled thinking shaped by the reality principle. Day-dreaming, with its partly subconscious direction, becomes significant.

Complexes and Libido. A Freudian concept of wide bearing is the complex, which summarizes a psychic relation surcharged with emotion, more intimately, as Freud views it, a fixation of the libido. Libido is the psychic expression of the sexual sphere broadly conceived as attachment and the vital urges generally. The infant libido is largely fixed upon itself, ego libido; but the erotic diffusion is regarded as beginning early, so that the oral sensations as well as fondling and caressing enter into the sensory experience and remain, even when the libido is gradually

transferred to the genital zone. Because of the intimate character of the child parent relation, this undue fixation and dependence develops a complex. The Oedipus complex, in which the son's libido is fixed upon the mother, becomes the nuclear complex of the neuroses. The similar fixation of daughter to father is called the Electra complex. Both terms refer to the plots of classic Greek tragedies, but Oedipus is used as a generalized term applicable, with due changes of relation, to both sexes. In both instances there develops jealousy, and the desire to usurp the parent's place; when sexually interpreted, this becomes the incest urge. There thus arises the family romance which becomes the central plot of the Freudian drama.

As Narcissism is the arrest of the libido upon the self, so fixation, or mother image, is its arrest in development; regression is the settling back of libido to earlier stages; repression is the damming of the flow of libido; sublimation, its desirable transfer to outer channels, thus becoming a form of object libido. Cathexis is another name, later introduced, for this intensive libidinal, or non-libidinal, energy. Fantasy is an introversion of such psychic energy. There are thus both developmental stages and a variety of further mechanisms, called dynamisms by Dr. Healy, which appear in the course of growth, or in application to dream incidents and neurotic symptoms, and more generally in the difficulties of character development. There is much rationalization of trends, justification of behavior to disguise deeper motives, compensation, projection, identification—all substitutional outlets for primitive urges.

Varying Formulations. The deviations from Freud's doctrines by his leading disciples indicate the core of the system and the focus of controversy. Agreeing that the fundamental urges determine the course of life, the divergence places these urges in different perspective. To Freud, sex not only remains central and pervasive, but sets the course of development and the differentiation of character. It is equally the theme of the family romance, the core of maladjustment, of childhood fears, obsessions, and fixations, the clue to myths, to the customs of totem and taboo, and finds elaboration in the castration complex, and types of oral, anal and genital character traits.

Jung rejects much of this doctrine, looks upon libido as psychic energy, and regards the urge to power and ego expression as the major foci of complexes, conflicts and neurotic entanglements. He holds also that it is the immediate situation and not the remote reverberations of childhood shocks, that is responsible for conflict. His account of complexes, of social maladjustment, takes on a broader aspect closer to the psychiatrist's interests. He has developed the association method of detecting complexes, which may be as near to the surface as a sense of guilt under accusation. He makes central the problem of psychological types, the distinctions of the extravert and introvert, and their subvarieties in terms of the parts which sensation, emotion and reflection play in the composition of character. His expansion of the symbolism,

including the symbolism of dreams and literary expression, is in freer terms. He shares with Freud the interest in the cultural applications. Sex remains important, but fuses with the dominant factors of ego assertion.

Alfred Adler departs more widely from Freud and stakes almost the entire interpretation of maladjustments and neurotic thwartings on the inferiority feeling in competitive relations. He began with organ or bodily inferiority and the compensations which it induces, but proceeded to make the focus of his system general psychic inadequacy and a disharmony between the way of living and the goal of desire. It thus becomes a general adjustment program with a psycho-analytic turn.

Freud has enlarged his system in later formulations. He finds it necessary to assume in addition to the unconscious and pre-conscious processes, an ego for the ordinary conscious control, and a super-ego, which in a measure parallels conscience and the spiritual values; and to postulate as underlying all else, a biopsychological Id, which is the primal basis of instinctive energy. This in turn may be summarized by such terms as the primary function to embrace all that is Id-like, and the secondary functions for the ego and super-ego regulations. All this is so speculative that Freud frankly calls it a METAPSYCHOLOGY. He likewise finds a destructive or death urge, the Nirvana trend to maintain life on as low a level of excitation as possible, the repetition compulsion to restore and live over again earlier emotional episodes. He uses the term Eros as an enlarged general life instinct, opposed to death and destruction; and through it all runs both the opposition of polarities, ego and world, pleasure and pain, love and hate, masculine and feminine, and the conjunctions of ambivalence sharing at once in both attitudes or an alternation between them. Clearly psychological theory launched in this vein and with such speculative freedom is unlimited in its assumptions, and finds its justification only in the dubious support that the concepts are needed to interpret psychoanalytic data.

For a score of years, from 1890 on, Freud's doctrines made little impression; they aroused violent opposition as unorthodox and unsound. The exaggeration of the sexual components formed an acute point of attack. From 1910 on the tide definitely turned and the psychoanalytic movement made great headway. It found a considerable following in the United States after the visit of Freud and Jung in 1909. Psychiatry under the leadership of Charcot and Janet in France, of Kraepelin in Germany, and Bleuler in Switzerland was definitely turning to the recognition of psychological factors in the origin of the neuroses and psychoses. Yet orthodox psychiatrists have opposed the exclusive psychoanalytic approach and the treatment particularly. Some question the foundations completely, and in that view are supported by a large representation of psychologists.

The lack of scientific verification, of experimental proof particularly; the absence of any adequate biologi-

cal foundation for so cumbersome a system of psychic behavior; the dissensions within the psychoanalytical ranks; and, most of all, the arbitrary employment of strained hypotheses, far-fetched symbolism, combine to place the system in the judgment of many critics beyond the pale of science, when that term is strictly interpreted.

Yet psychologists and psychiatrists equally have recognized the central aspects of Freudian doctrine as suggestive and illuminating, while declining to follow Freud or his disciples in the details and the extreme deductions. The later developments of Freud's views are likely to accentuate the divergence of opinion, and make psychoanalysis a continued subject of controversy.

Applications. The broad bearing of the leading Freudian interpretations of human motives and behavior patterns has contributed largely to the interest in psychoanalysis and the incorporation of Freudian points of view in the popular thinking. The establishment of the principles depends upon their pragmatic value. The psychotherapeutic treatment for the relief of neurotic impediments is in itself the leading practical contribution. Does psychoanalysis cure? And in what cases, and by what mechanism does consciousness cure? These are vital issues. In such practice there has developed the theory of transference, by which the fixation responsible for the troubled libido must first be directed toward the analyst, who in due course relieves the burden and sets the patient free. The benefit of this procedure and the general desirability of bringing to conscious reflection reserved areas of personality have been questioned. Clinical records are uncertain and the play of suggestion large.

In application to education the leading ideas have been more generally approved. They have directed attention to the critical importance of childhood responses, to the dangers of over-repression, of too great indulgence, or too great severity, and given child guidance a helpful clue, as the stimulation of independence. (See CHILDHOOD, PSYCHOLOGY OF; ADOLESCENCE.) In a similar direction the nature of religious experience, alike in its normal and extreme expressions, has received illumination.

Pursuant to these leads the Freudian system has developed to a comprehensive insight into character formation and the adjustment of personality.

The Freudian concepts have been applied to the interpretation of cultural products. In *Totem and Taboo*, Freud brought the anthropological field of custom, myth and fairy-tale into the purview of his psychology. Racial development in the intricate movement from savagery to civilization proceeds by stages capable of interpretation by similar categories and situations. Myths are in a measure the expressed dreams of the race; fairy-tales follow similar plots; customs embody urges, resistances and subconscious gropings toward solutions. Literature has been profoundly affected by Freudian ideas, and psychobiography has arisen as a psychoanalytic delineation. The personal and intimate aspects of public men and

historical personages, and the great dramas of power, conflict and empire have similarly been emphasized under this enlightenment.

Summing it all up, despite the extreme and unscientific developments that are so prominent in the Freudian movement, it has permeated every phase of human interest and restated many of the most important aspects and disciplines of the art of living. It has ambitiously attempted a reconstruction of the psychic life in process and product. The reflective world will never return to a pre-Freudian viewpoint. J. J.

BIBLIOGRAPHY—Freud, *Interpretation of Dreams*, 1900, Barbara Low, *Psychoanalysis and Education*, 1920, Van Teslaar, editor *An Outline of Psychoanalysis*, 1925, Peck, *The Meaning of Psychoanalysis*, 1931

PSYCHOGALVANIC REFLEX, the name given to the process by which the electromotor changes in the organism are measured. The hand may be attached to a galvanometer, which indicates a deflection due to the presentation of a noxious stimulus. A pin prick, or any other harmful stimulus capable of producing a change in the emotional current, may be used. The psychogalvanic reflex has been found useful in detecting complexes in the psychopathic, and is also of importance in examining criminal cases.

PSYCHOLOGY, the science of mental life. This is perhaps the most enduring definition that can be given, although it has been criticized and its meaning interpreted in radically different ways by changing conceptions of mental life in modern times. To-day this science does not recognize as its object the soul as a distinct entity or mind as distinct from body, nor does it restrict itself to the study of consciousness or of mere behavior. The term mental life has obtained a new meaning from the current philosophical approaches to the mind-body problem, which tends away from the dualistic point of view and from both materialistic and idealistic monism toward a conception of mind which is in harmony with facts of natural history and experiment, and regards mind and body as aspects of the same fundamental phenomenon in organic life. Psychology thus deals with the organism as a whole, but with the mental aspect as its domain and point of departure.

Phenomenal Growth. Psychology had its rise within the memory of men now living. It has had a phenomenal growth and is now tending to reach out into all fields of human activity. From present indications, it seems reasonable to suppose that in the future there will be as many mental sciences as there are material sciences. If one should take a dozen pages selected by chance in a large dictionary, one would find that there are probably as many words which refer to mental facts, activities and events, as there are for physical facts, activities and events. The same will be borne out in daily conversation, be it table talk, business, or play, and in all other individual and social interests. Even in the case of the miser, whose interest is in the dollar, his mental ruminations are largely about how to influence men or situations for the increase of his hoardings, or the various types of satisfaction that he derives from them.

The present term psychology is therefore a fundamental concept which already has split up into a number of distinct branches and will continue to do so in the field of pure mental science. But the expansion is far more notable in the field of applied psychology or psychotechnology in which there is now a tendency to develop a psychology of every distinctive human interest and activity, such as business, art, industry and disease. A striking illustration of the need of such extension is seen in the treatment of the last mentioned item, disease. Reliable statistics show that at the present time there are as many mental patients as there are physical patients in the hospitals of this country. When one considers that the training of physicians has been, and is yet, almost entirely on the physical side, one realizes that these mental patients are not receiving adequate treatment. Indeed the profession of psychiatry is so new that it is still treated as an elective post-graduate study, frequently in the form of internship. There is no adequate supply of psychiatrists, and the public is not aware of the need or the possibilities of their service. We are just at the beginning of a great awakening to the need and possibilities of this type of service.

When one considers the wide range of mental disorders from insanity down to countless cases of special disabilities, it is evident that foundation for the art of diagnosis and treatment of these calls for vast extensions of pure mental science to meet new situations, and the development of enormous new fields of psychotechnology. Criminology and penology are coming to be psychiatric problems primarily. Re-education as a treatment of all sorts of special delinquencies and defects must be in the hands of clinical psychologists. The expansion of the understanding and treatment of disease has its analogy in every field of human endeavor, such as industry, international relations and art. Thus the development of knowledge and control of social order, criminal law and preventive medicine are now contingent upon knowledge of human nature, the way the human mind actually works and the means of modifying it.

To illustrate further how knowledge of the specific facts about mental life projects itself into countless apparently unrelated situations, we may take the case of psychology of hearing, which is but a small part of the field of sensory experience. A psychologist who is an authority on hearing is called upon to furnish expert advice and leadership wherever hearing functions: for example, in medicine, in the treatment of disease of the ear or brain lesions affecting hearing; in architecture, on acoustic qualities of rooms; in aviation, as dependent upon functioning of the ear; in war, for the location of enemy crafts; in music; in aesthetics; in the science of speech; in broadcasting; in education, to the countless problems of development, utilization and refinement of hearing. In short, wherever efforts are made to establish practical facts depending upon a scientific knowledge of the nature of hearing, the psychological specialist finds a place. This accounts for the fact that the psychologist is often

charged with the pretense of knowledge of an impossible realm of problems; whereas, as a matter of fact, if he is an authority on one specific little field of psychology, the same core of information and technical skill operates in whatever direction he turns for application of this knowledge as in the above mentioned avenues. Or, to put it in an impersonal way, a scientific fact about the hearing, such as the specific nature of tonal timbre, once firmly established, transfers into every field of human activity in which the hearing of tone quality functions.

Present Trends. The present trend is to ignore distinctions between the theoretical and the applied and to employ as strictly scientific principles in applied psychology as in pure psychology, with the anticipation of deriving not only the technological facts which are the immediate goal, but a deeper understanding of each process with deeper and deeper observation of actual facts under experimental control. This is well illustrated in the field of psychology of music in which the object is to discover and organize the principles that constitute a foundation for musical aesthetics, musical pedagogy, musical criticism, and the art of developing musical skills. The pursuit of any of these practical ends invariably leads to a deeper insight into the nature of the human mind as it functions in some aspect of this art.

Again the present tendency is to ignore the distinction between mental science and material science, and recognize countless units of interest which are approached with an intimate knowledge of both mental and material sciences and without any effort to distinguish the two. This was exemplified in the above illustration in psychiatry, the object of which is to diagnose and treat mental disease. In this practice, neuro-pathology and psychopathology are on a common basis, inseparable for the understanding and treatment of mental disorders. Eugenics, the science of being well born, cannot divorce the mental and the material aspects in any general treatment of the problem. If the object is to produce a race of mentally superior men, the problems involved must be approached from both sides. In the psychology of advertising, which is one of the best developed fields of applied psychology in business, the problem is to create in men and women a disposition to buy particular goods. Although the scientific study of this problem began as a purely psychological problem of how to make an impression, how to make it lasting, how to motivate decision, etc., such problems have been absorbed in the technique, language and practice of business, so that in a course on marketing or in the practices of the specialist in the advertising firm, one finds to-day all the facts which a decade ago were distinct contributions from psychology and a constantly growing body of that kind of data. Therefore, there is certain to be a large increase in a number of the distinctive fields of applied psychology, such as the psychology of language, of art, of sport, of economic value, of educational personnel and industrial personnel, creative writing, international peace, religion,

morals, etc., fields already running into the hundreds in inceptive stages. But in most fields the distinctly psychological character will be lost in their combination with other approaches, both science and art. When psychology is projected into new fields of knowledge and art, either pure or applied, it tends to lose its identity and becomes a part of the common stock of knowledge from all sources bearing upon that problem. For this reason there will be as much interest given to the study of the mental aspects of phenomena of this sort as is now given to the physical aspects. A striking example of this is the problem of national defense which is more and more becoming a psychological problem and a solution of which is going to be infinitely more significant from the psychological point of view than from the point of view of armament.

Divergence among Different Schools. At the present time, there is much concern in psychology about the great divergence among different schools. These schools are characteristic of the development of a new science, and will flourish until the most vital approaches to the subject as a whole, both as to content and method of procedure, have been explored. It is generally agreed by the main body of psychologists that none of these schools have the whole truth or the permanent solution. On the other hand, the great majority of psychologists are profiting by the new points of view, and the whole subject is progressively enriched. Schools will flourish in any subject until the whole field is covered fairly comprehensively by experiment. Behaviorism, psycho-analysis, structuralism, individual psychology, Gestalt psychology, purposive psychology, all enrich the subject; but each is but a passing wave in the process of evolution of the science as a whole which goes on steadily. This attitude toward schools has been called the middle-of-the-road attitude, and probably represents the majority of American psychologists to-day.

Real progress takes place wherever we can introduce controlled experiment. Most of the phenomena may be approached experimentally from the point of view of any of the schools; and, to the extent that the experiment is done thoroughly, the results from all sources will tend to agree. For example, 20 years before the appearance of the term *Gestalt*, experiments on illusions led to exactly the same finding that the Gestalt school is obtaining now on a so-called new theory, because both experiments were valid and thorough and yielded a deepened insight into the nature of the process.

So far we have aimed to show how psychology reaches out and expands in various directions into a number of sciences, each with its specific content, objective, or method. We must now ask ourselves what after all is the basic content for these various psychologies? For the purpose of classification, description, and explanation, we may recognize certain fundamental types and levels of mental activity.

Man's Original Nature. First in this classification is that of the nature and order of appearance and

development of hereditary traits variously classified as reflexes, instincts, urges and drives, with which the child, from birth or soon after, is equipped to respond to the environment without previous training. These are in large part the raw materials on which modifications and combinations are built up into the more complex forms of activity. This native equipment with which the child comes into the world, is purposeful, vastly more complicated, and biologically more significant than is generally recognized. Much of the explanation of higher mental processes hinges upon a correct interpretation of the character and ramifications of these elements of original nature. Even the interpretations of the most attenuated aspects of social movements and organization, like expressions of art, sport, learning and talent, hinge upon the point of view taken with reference to these native equipments which blend imperceptibly into the early development of the abilities, such as habits, skills, adaptations and attitudes.

Like the higher animals, man comes into the world with psycho-physical equipment ready to cope with the environment, but with this difference that just to the extent that his organization is higher than that of the lower animals, the period of infancy and stages of growth are longer drawn out. All parts of the brain are organized for everything that a mature man shall do. The sense organs are equipped early and serve as physical receptors. The voluntary muscular system is all harnessed ready to be driven, and the autonomic nervous system is in full action and not subject to great change through growth. Mental processes probably operate at the earliest stages somewhat in the way that reflexes and random movements manifest themselves. But there is no consciousness of relations, and the activity which goes on may perhaps be recognized as belonging to the level of the subconscious. In other words, we should not assume that mental activity of the infant in its first days is limited to those evidences of conscious activity which the adult recognizes in terms of his own experience. The father would probably be grossly fatigued if he should go through as many movements during the 24 hours of the day as the child does within his first year. It is reasonable to suppose that the child is equally active mentally, reacting to a new world very much in the same way that his random impulses in great masses come in the form of impressions which lead to uncoordinated responses.

In its bearing upon interpretation of mental life as a whole, the earliest psychology was concerned with the problem of innate ideas. This gave way to the concept of instincts, and this in turn to reflexes. In the over-simplified system of behaviorism, the whole problem is reduced to that of the inborn reflexes, and how we can condition them. The probability is that instincts will be interpreted in terms of reflexes and with a very much enriched connotation given to the latter term.

Sensory Responses and Experience. The ancients spoke of the sense organs as the windows of the

soul, the medium of communication with the outer world. Man could well get along with a single sense, for example, sight or touch, but he is normally equipped with many senses, each leading to an entirely different approach to the same object, as for example, in the eating of an orange. It may be said literally that man lives in a visual world, an auditory world, a tactual world, etc., each furnishing an entirely different approach to the world, but all contributing to a more rich and efficient awareness of surroundings. To the classical five senses, sight, hearing, smell, taste and touch, we generally add recognition of the sense of temperature, the sense of pain, the kinaesthetic sense, and the sense of equilibrium.

In the earlier psychology, the problem was, what experience comes to the individual through a given sense? An equally narrow conception is, to what response does the sensation lead? Modern psychology combines these two, recognizing the physical mechanisms for stimulus and response which are harnessed in certain ways and the experience or information that comes through the sense impression, as well as the higher mental and central brain processes ordinarily involved as the middle link in any stimulus response.

The terms sensory experience and consciousness are too narrow terms to represent mentality at this level. After the fog of all psychological "isms" has cleared away, we shall probably give a very prominent place to mental activity in the field of the subconscious. It may be said literally that while hundreds of impressions upon my senses are made every minute, I experience or am conscious of only a very few, and each of these only in a very fragmentary way. Nevertheless, the mental associations are being made. Corresponding to the conscious process of perception, there is a web of intricate subconscious associations constantly being woven in such a way as to constitute a continuity with a conscious experience, and this is so registered and retained that it operates throughout all mental life on the same general principles as does the conscious experience. It is therefore wrong to interpret sensory experience as limited to those evidences of conscious activity which are observed in children. The mental growth in the early stages is perhaps vastly greater at the subconscious level than at the conscious. Every sensory impression leaves a trace, and we have no grounds for thinking that mentality is limited to consciousness. This issue between the conscious and subconscious has been beclouded by the various theories of the relation between body and mind, but the theory of this relationship indicated above removes this conflict by refusing to recognize this double aspect and yet holding to the reality of mental processes at all levels.

In reality one cannot study either the mind or body in vacuo. The living organism is one organism. Therefore we cannot understand a perception of red without knowledge of the anatomy, physiology, embryology, and physics of the eye, and the accessory nervous and muscular organisms. Yet there are convenient divisions of labor in the field of vision for the

anatomist, physiologist, physicist and psychologist. This is characteristic of all studies on the human organism. The studies on the cortex of the adrenal glands, for example, have attained a rich significance through the recognition of their relationship to mental powers. A certain hormone may be looked upon as a trigger which can release, heighten or block each and every mental capacity. The great thing in life is, however, experience. It is the center of human interest and concern, and the psychologist will always have his full share and more of the responsibility for explaining life, in spite of the fact that to each scientist it may appear that the whole problem is his problem.

Memory and Imagination. Every man lives much more in the field of memory and imagination than in the field of sensory experience. When I listen to a bugle tone, I not only hear that tone, but experience vast masses of related associations through many of the senses, such as the tramping of soldiers, hunger and strain, in various degrees of shading from the conscious to the deep subconscious, which cluster around that hearing. This is the revival of past experience, the tying up of the present, and projecting of the present into the future, much of which may take place in a single moment of perception. On the other hand, this life of association becomes the central object of attention and is the medium through which mind achieves. In the life of the student, for example, all memory, all facts learned, all injection of meaning into these memories, and all the forward projection of present and past experience into the future is of this associational sort. Normal consciousness of it takes the form of imagery. For example, when I remember my house, I see it, and can experience it through other images. But conscious imagery is not necessary and plays only a very small part in this life of association.

Overtly conscious events, whether in perception or in memory, dig deep into the whole subconscious realm of related experiences. From the neurological point of view we state this by saying that the adequate stimulation of specific nerve centers in the brain arouses not only that specific center or cell, but affects the living organism as a whole, not only the brain but even the muscular and vascular systems however remotely and minutely. It is for this reason that psychology limited to discreetly conscious events touches mainly the surface.

Memory and imagination are the two aspects of the operation of the laws of ASSOCIATION, one dealing with reproduction of past experience, the other with imagined experience, past or future. The laws of association may be stated adequately from several points of view. Thus to the psychologist a purely neurological statement of the laws of association means the same thing as a purely psychological statement of the parallel concepts. These so-called laws may be primary or secondary. As primary, we ordinarily recognize the laws of similarity, contrast and contiguity; and, under secondary principles, the laws of primacy, recency, intensity, repetition and emotional congruity. In the same manner, the laws of memory may be

stated either from the purely neurological or the purely psychological point of view, both meaning the same thing to persons who recognize the true relationships. Yet to the psychologist, the significant thing is the mental fact that is impressed, retained, recalled or recognized as a fact of experience. Memory, particularly as represented in studies of learning, has been one of the fertile fields for psychological investigation, and the recognition of its importance and possibilities is growing since it is the fundamental process of all education. On the other hand, as psychology reaches out into the foundations of art, music, drama, invention, in short, all forms of creative activity, a similar interest will be built up around imagination which is as yet little known or understood. Both memory and imagination, we have said, may operate through images, and these images may be in each and every one of the senses. But there are very large individual differences in the permanence of the imagery and in the dominance of imagery in different senses. Thus one individual may be largely a visualizer; another one may be an audile, living largely in the field of hearing, as in the case of a musician who can create a major composition and hear it out in minutest details without ever producing or hearing a physical sound. He works through auditory imagery.

Recall is most effective when it is automatic, as for example, when my hand goes to the door knob without my even looking at it. This is best illustrated in manifestations of skill. No one can play the piano or run the typewriter so long as he thinks this finger, this key. He plays the piano or operates the typewriter with skill only when all the intricate memories involved in the performance are automatic, leaving his mind free to operate at higher levels of meaning and feeling. Thus in discussing mental life at this level, we feel justified in emphasizing the very large rôle that memory and imagination play in normal life, and the fact that memory and even to a large extent, imagination, are most serviceable when automatic, leading immediately and without consciousness to the end sought.

Thinking. Thinking is perhaps the capstone of mental life. It represents the elaboration of experience in terms of ideas leading to new ideas. There is a somewhat cynical remark among psychologists to the effect that animals do not think, and human beings think very little. Taking the term in the strict sense of reflective thinking or reasoning, this is true. The term thinking, however, is used in a broader sense, from the ability to meet new situations by carrying over a concept from previous experience however simple up to the most abstruse and deliberate processes of reasoning. Thinking at the lower levels goes on continually in normal persons although in an abbreviated form. Reasoning is a process which is undertaken with effort requiring sustained attention and a natural capacity and power of hesitation, deliberation, abstraction and choice.

The older psychology of thinking was largely applied logic. Modern psychology lays emphasis upon

the simpler forms of thinking, showing how all thinking is an outgrowth from simple adjustments to situations ordinarily not recognized as requiring thinking, but as mere action or response. The Behavioristic school attempted to describe the process of thinking entirely in terms of overt, inceptive, or subvocal activity. The traditional account which, however, prevails, and is likely to prevail, recognizes the process of imagery, conception, judgment and reasoning. As there are numerous differences in capacity for thinking, there are corresponding differences in ways of thinking; but most persons, whether they are conscious of the fact or not, experience images, percepts, and acts of deliberation and choice, more or less consciously.

However, instead of the mechanistic account of reasoning in terms of images, concepts, judgments and choice, modern psychology approaches it from the functional point of view, recognizing the enormously rich background and interrelations which exist with even the simplest higher mental processes. This does not discard our traditional notions of images, ideas, judgments and choice, but gives a far richer setting than was ordinarily recognized in structural psychology. For example, the concept of a blizzard involves reverberations of experiences in resistance to the wind, chill, shivering, whiteness of snow flakes, darkening of the atmosphere, impact of snow, drifting, swaying of trees and sighing of the wind. Therefore when the concept blizzard arises in my mind, I actually go through the sensory experiences associated therewith, experience the motor responses in more or less inceptive stages, feel an emotional tone due to the response of the whole autonomic system of nerves and glands. Countless unrecalable experiences well up through the subconscious to reinforce or relate this total response of the psychophysical organism. This is what it means to have an idea, whether it be an idea of an objective situation, such as a blizzard, or a purely abstract idea of a principle of beauty. The total organic response is present in the setting of the idea of the abstract as in the idea of the concrete. While the rôle of the conscious image is an important factor in the reasoning process, the image like the concept has this very rich and complete setting in the reaction of the organism as a whole, and it is this setting rather than the concrete image in itself which operates through the laws of association in the course of the thought process. The same is true of the act of judging which is ordinarily conceived of as a process of abstraction, generalization, recognition, meaning and decision. Each of these various stages of the thinking process usually operates in more or less abbreviated form at the conscious level, but is influenced by the network of the associations inherent in images and ideas compared.

Thus in an account of a thought process, we must recognize the laws of the development of images, the growth of concepts, the development of skill in deliberation on the one hand; and on the other hand, the large individual differences, the method of procedure

and the natural limitations, sources of error or fallacies involved at each stage, and bear in mind that a thought process is a response to a new situation by the organism as a whole.

Feeling and Emotion. So far, we have discussed the cognitive processes with the indication that each tends to find expression in some form of action. To this we must add a further idea that every cognitive process is tinged with feeling. Organically, this means that for every impression or idea that comes into the mind, or every action performed, there is a tendency toward either attraction or repulsion, like or dislike, pleasure or pain, in various degrees of attenuation. When my eyes fall upon a choice, well-cooked steak, the organism takes the form of attraction, and I experience agreeableness, liking or pleasure; whereas, if it should be badly cooked, the response would be the opposite. This principle is true at all levels of cognition, not only from perception up to the abstract thought, but also for all of the underlying subconscious cognitive processes. The object is attracted to the organism, or it is repelled, as expressed in the action not only of the voluntary muscles, but also of the smooth muscles of internal glands. When this attraction or repulsion is marked, it becomes conscious in the form of agreeableness or disagreeableness, like or dislike, and in an extreme case, pleasure or pain. But whether it is conscious or not, the principle of attraction or repulsion always operates.

Thus we have a biological foundation for the expression and experience of feeling in the fact that all experience has meaning for the organism, implying something that is good for the organism or not good for the organism, using the terms in the most comprehensive sense. The organism responds unconsciously in either of two modes: indications of the beneficent, or indications of the noxious, for the system. From this foundation, the whole psychology of emotion is built, and while we recognize that all cognition tends to run into action, we must recognize with equal force that all feeling is action and tends to run into consequent action. Thus, the whole mental life operates as one system in suspension involving three angles, cognition, feeling and action, and one never operates without the other.

Action. The psychology of action naturally suggests a classification on the basis of the sources which lead to the action. Thus we have already considered reflexes, which in their simpler forms arise immediately from the stimulus, and instinctive action, which takes place as a result of inherited tendencies, although vastly modified by experience and always conditioned upon the presence of an adequate occasion. We have noted also that the action follows from the image just as from the sensation, and that although in a very remote way, the abstract idea tends to be consummated in action. Aside from these specific sources, there is a whole body of actions which result from feeling, which might sometimes be described as undifferentiated mass cognitions. The feeling of attraction leads toward the object or makes movement to

apprehend the object; feelings of repulsion tend toward movement away from the object, or movement to repel the object. These actions which arise in feeling may be from the very simplest sensori-motor type in which the affective element is present upward to the highly cultivated emotional reactions toward truth, justice and beauty, or other opposites. Since most of these reactions are more or less automatic, they present the largest mass of actions in daily life. That is, I have a leaning in this direction or that direction, and in so doing, take countless steps to maintain the balance of the organism.

On the affective side, we also recognize different levels of origin, such as, simple affection, feeling, deep emotion, impulse, passion and sentiment, as distinctive levels of affective life which leads to action. It should be born in mind also that a large part of emotional life itself is action, and that the experience of emotion is in large part consciousness of this action. The older psychologies devoted much space to the subject of will, which modern psychology treats specifically in terms of voluntary action. Ordinarily, action is classified into voluntary or involuntary. The voluntary acts are such as represent the outcome of conscious deliberation and choice; whereas, involuntary acts are such as reflexes, habits, random acts and certain elements of impulsive action.

Such in brief is the constituency of mental life, which is the object of mental science and constitutes the primary core of all psychology. Different branches of psychology, pure and applied, simply represent specializations around a certain situation, such as the psychology of singing; specialization in mode of approach, such as the genetic or the physiological; specialization, division of labor as in the normal or the abnormal, the adult or the child, man or animal.

See also ABNORMAL PSYCHOLOGY; ADOLESCENCE; CHARACTER, PSYCHOLOGY OF; CHILD PSYCHOLOGY; DREAMS; EVIDENCE, PSYCHOLOGY OF; EXPERIMENTAL PSYCHOLOGY; GENETIC PSYCHOLOGY; GENIUS, PSYCHOLOGY OF; HYPNOTISM; INDIVIDUAL PSYCHOLOGY; INDUSTRIAL PSYCHOLOGY; INVENTION, PSYCHOLOGY OF; PERSONALITY; PLAY, PSYCHOLOGY OF; PSEUDO-PSYCHOLOGY; PSYCHOLOGY, COMPARATIVE; RACE PSYCHOLOGY; SELLING, PSYCHOLOGY OF; SEX, PSYCHOLOGY OF; SOCIAL PSYCHOLOGY; SPEECH, PSYCHOLOGY; SUBCONSCIOUS; TESTIMONY, PSYCHOLOGY OF; WORK, PSYCHOLOGY OF. C. E. S.

BIBLIOGRAPHY.—Warren and Carmichael, *Elements of Human Psychology*; J. F. Dashiell, *Fundamentals of Objective Psychology*; C. E. Seashore, *Introduction to Psychology*; F. H. Allport, *Social Psychology*; E. S. Conklin, *Principles of Abnormal Psychology*; F. A. Moss, *Applications of Psychology*.

PSYCHOLOGY, COMPARATIVE, in the most inclusive sense, comprises three orders of mental data: (1) the varieties of animal intelligence; (2) the cultural steps from primitive to most civilized societies; (3) the genetic stages from infancy through childhood and youth to maturity and decline. The last, or ontogenetic series, belongs more properly to genetic psychology, as the stages follow in the same organism. (See CHILD PSYCHOLOGY.) The second involves complex considerations of social direction, centering in the

varieties of primitive cultures, and thus constitutes the psychological division of ANTHROPOLOGY. The first, or phylogenetic series, forms the central content of comparative psychology, which term as ordinarily used refers to the psychology of animal behavior.

Early Observation of Animal Minds. The close relation of primitive man to animal life, as hunter, trapper and domesticator, developed a nature study as well as a system of magical rites and religious observances, such as the customs of totem and taboo, in which animals close to human interests played a dominant part. This animal cult invited the observational study of animal behavior which received attention among the Greeks, especially by Aristotle (384-322 B.C.), the first great naturalist, and later by the Roman Pliny (23-79 A.D.). Aristotle recorded extensive observations upon the senses, the instincts, the memory and intelligence of animals, and their capacity to be trained. Though in part credulous and accepting tales by hearsay, he comments with insight upon the temperamental differences of animals, their intellectual and "moral" characteristics, bringing them into his general system of psychology as derived from a study of human qualities.

The pattern of anecdotal observation and interpretation thus set continued until the scientific trend, which may be conveniently dated from the period signalized by Harvey's discovery of the circulation of the blood in 1628. Waiting upon the enrichment of knowledge of the great zoologists of the 18th century, Linnaeus, Buffon, Reaumur, Lamarck, Erasmus, Darwin and Cuvier, the study of animal behavior proceeded mainly as a collection of anecdotes of unusual sagacity or even of marvels of behavior approaching the human pattern. Just as the animal species themselves were regarded as issues of special creation, so equally were they considered to be endowed by the creator with a repertory of original instincts that determined their ways of life. With the appearance of Darwin's *Origin of Species*, 1853, the zoological relations were brought into the comparative view of evolution. The clue and stimulation to the interpretation of animal behavior thus supplied, marks the renaissance if not the foundation of animal psychology.

A central point of issue was whether the older notion of a complete separation between the reason of man and the instincts of the beasts could now be replaced by a continuous series, assigning the beginnings of reason in progressive elaboration to the minds of the higher animals. The anecdotal tendency to describe animal behavior by the patterns of human favored this conclusion, but did so uncritically. Neither view developed a consistent genetic study. This involved an experimental approach, a fresh start to determine without bias, and by aid of the nervous structures of animals as well as in accord with the concepts of adjustment of organism to environment, just what animals could do by original endowment and by profit of their own experience, as well as what they could be taught by training under human redirection. The domestication, or taming, as well as

training of animals, by selective breeding for special qualities useful to man, supplied an important body of evidence that could be reinterpreted in the light of experimental study.

The Scientific Era. With the development of the experimental method, comparative psychology became truly scientific. In this movement the contributions of C. Lloyd Morgan, the mechanistic view of Jacques Loeb, the researches of Thorndike and Yerkes, all dating from 1890 onward, have a directive part. Loeb's acceptance of the tropism, a term originally applied to the movements of plants turning toward the sun, as the earliest, simplest mechanism of response favored a physico-chemical view of the process, and thus eliminated the disputed factor of consciousness. The moth flying into the candle flame, or flies clinging to the ceiling, as well as the reactions of infusoria, as of the amoeba in ingesting food particles, were presented as variations of tropismic action. Jennings's careful observations showed variability of response even in the lowest invertebrates, and a modification of behavior which involves all the essential data of what came to be recognized as the trial and error pattern. The logical criterion of Morgan, that actions capable of interpretation as of a lower scale should always be so interpreted, remains sound and forms a tenet of BEHAVIORISM as well as of evolutionary psychology.

But comparative psychology recognizes levels of behavior, however uncertain their boundaries or origin. They are indicated by the structure of the organism, and specifically by the complications and specialization of the nervous system, and by the functional criteria, the range and discrimination of the responses, by their modifiability, especially under training, and by the initiative displayed in exploration and solution of situations.

Typical Experiments. The typical experiments constituting the data of comparative psychology may be indicated. Rats placed in a maze at the terminal of which is food, begin by constant running in and out of blind alleys and trying false trails, and may travel 40 times the run necessary to reach the food when the path has been learned. Learning consists in eliminating errors and is gradual; the number of trials to learn a simple maze being much fewer than for a complex one. To determine what indications the rat uses, in turning the eyes, nose, feelers, called exteroceptive organs, were eliminated, with the result that blinded rats, those deprived of the sense of smell or with the whisker-hairs cut, find the way as well as normal ones. This negative evidence points to the kinaesthetic or muscle-sense feelings, which are called proprioceptive organs, as the source. This conclusion was confirmed positively when rats trained in one maze were transferred to another of the same pattern but with the runs lengthened out, in which case the rats turned too soon, or with the run shortened, in which case they ran by the proper turns. It does not follow that the sense organs afford no clue, but only that the dominant clue is kinaesthetic.

Typical and more complicated are the arrangements of puzzle boxes to be opened and food obtained, or of cages in which the animal must operate levers, pull cords, turn bolts, etc., to escape. Here again a variety of random, or trial and error, movements are at first made by the hungry animal confined in a cage with food outside close enough to be smelled. It may pull and push, bite and paw, and go through all movements in its repertory. In time the useless movements are eliminated and the correct ones, with a few fumbings, carried out. The same process may be observed in a dog tied by a cord which has become entangled around a post. The dog will try one side and find that it tightens the leash, then the other and find that it releases it.

The experiments proceed to analyze the complexity of the behavior patterns. They reach their highest expression in the performance of apes that learn to pile boxes one on the other, to join two parts of a telescoping bamboo pole, or to run rapidly up a pole and jump for a banana suspended from the ceiling. In these learnings there is both initiative, the sudden and complete solution following upon reflection after failure, and the possibility of imitation by observing the successful performance of another animal. In addition the Gestalt psychology points out that the situation to which the animal responds, as well as its mode of response, is a combination of factors, a total pattern of situation rather than a specific element or detail.

A further experiment arranges in a semicircle a number of closed boxes, one of which contains food. Can a cat learn to go to the middle one whether the middle of three or of five or of seven boxes? Can it learn that the food is contained in the boxes next to the end, no matter how many in the series? Similarly if the box containing food shows the brighter of two lights, whether of low or high illumination, can this discrimination be learned? How quickly will an old habit be discarded when it no longer leads to food? It is by such procedures that comparative psychology is attempting to determine the common and the distinctive factors in animal and in human learning, and to trace the course of psychological complication in the animal series.

This selection of problems forming the data of animal psychology can do no more than suggest the range of a division of modern psychology that is as prominent as it is important. With increasing refinement of method the entire zoological range of animal behavior has been studied from infusoria to anthropoid apes. The literature is vast and must be referred to for an account of methods and results.

J. J.

BIBLIOGRAPHY.—Watson, *An Introduction to Comparative Psychology*, 1912; Kofka, *Growth of the Mind*, 1924; C. J. Warden, *A Short Outline of Psychology*, 1927; Hollingworth, *Mental Growth and Decline*, 1927; Warden, *A Textbook of Comparative Psychology*, 1931.

PSYCHOLOGY, HISTORY OF. Psychology as it exists to-day has been described as an ancient discipline with a short history. Speculation and tradi-

tional explanations of mental phenomena go back to pre-scientific ages; they have a place in the antecedents of psychology. Primitive peoples had their notions of mind; indeed their views of the world were largely psychical, as they conceived cosmic forces, the sun, stars, planets, seas, storms, groves, lightning, mountains and rivers, as personalized. Upon the basis of dreams, shadows and images, they imagined a world of spirits, and explained disease, death, failure of crops or of exploits as witchcraft, or as the anger of offended gods. They were given to divination and reading of omens. Much of this order of lore, which is psychology of a sort, survives through folk-lore channels.

Systematic psychology was foreshadowed in the Babylonian and Assyrian cults and in Egyptian mythology; much of it is of psycho-religious origin. Among the Greeks, in Aristotle especially, there were psychological inquiries, such as the nature of sensation and illusion, memory; there was the doctrine of temperaments, reflecting alliance with medical knowledge, and speculations concerning the function of reason. With the spread of Christianity, soul-lore and the moral religious considerations replaced the natural interest, while scholasticism still farther diverted the psychology toward metaphysical and theological views. Such psychology as there was became a side-issue of philosophy.

Early Psychology. Modern psychology had its forerunners in the 17th and 18th centuries. Descartes (1596-1650) conceived of animals as machines; while rational actions, such as those of man, were entirely distinct. He held to the doctrine of a soul, though seeking its place in the body. This problem of the relation of body and mind remained central. Leibnitz (1646-1716) explained it as a pre-established harmony. Hobbes (1588-1679) brought forward the distinction between the original nature of man and the results of experience. The latter interested him as motives, such as fear, desire for honor and gain, which determined the social and political life; in terms of these he analyzed acts and impulses. Locke (1632-1704) carried the problem back to sensations and the origin of ideas; he distinguished between primary qualities of sense experience and the notions derived from impressions by inference. Berkeley (1685-1753) was particularly interested in the world of space as we come to visualize and conceive it. He analysed the processes of vision on an Empirical basis, but in all else assumed a theological attitude; he assumed a soul to unify experience. Hartley (1705-57) turned the discussion toward the linkage or association of the elements of experience by which qualities were composed into objects and their relations. He referred the process to paths or patterns established in the brain. Condillac (1715-80) held that all thought could be built up of sensations. These fragments of doctrine illustrate how incidental to other interests were such aspects of the mental life as were available for a possible psychology; and the same would hold of the German contributions from

before and after Kant (1724-1804), which likewise looked to a source beyond the body mind relation for the explanation of mental phenomena.

Practical Interests. However such practical interests as the pressure of mental disorders and the treatment of the insane, the application of motives to economic life, the delineation of character, kept alive psychological interests. In the early 19th century, Herbart, who wrote a textbook of psychology in 1816, perhaps the first of its kind, constructed a quasi-mathematical system by which ideas combined and also contended with one another for a place in consciousness. Lapsed ideas form alliances with others and are reinstated. Past experience leaves its trace; interests or apperception direct further acquisitions.

A practical factor at this stage was the growing interest in anthropology, as indicated by Humboldt's *Travels*, and the recognition that primitive peoples developed a psychology of their own. Rousseau (1712-78) advocated a return to nature by way of exalting primitive man. In this stage of enlightenment such a reading of mental traits from facial features as Lavater's *Physiognomy* acquired great prestige; as did also so completely original a solution as Gall's (1758-1828) *Phrenology*, with an elaborate system of psychological faculties and their cranial location. Even 100 years ago there was little building material available for the construction of a psychology; the intellectual background for such a synthesis was lacking.

Naturalistic Psychology. With the advent of evolution in the middle of the 19th century the life sciences took on a new impetus, by which psychology profited. But the ground had been well prepared by discoveries as to the working of the nervous system, such as the notable one in 1804 of the distinction of sensory and motor nerves. Not until the biological unity of body and mind and its basis in the central nervous system had been abundantly established, was a scientific, or naturalistic, psychology possible. In line with the same illumination was the genetic view of mental phenomena, the analysis of animal behavior, the study of the development of the child, while the medical interest in mental disorder formed a continuous tradition. Combining these several approaches, Wundt (1870) founded a psychological laboratory, thus emphasizing the experimental technique. Yet the text comprehensively covering the new discipline was properly called *Physiological Psychology*. Modern psychology is hardly more than half a century old. Yet before the days of Wundt the relation of stimulus and sensation was investigated by Weber and Fechner, who formulated the psychophysic law. The study of sensory processes continued, but the inclusion of general reactions involving distinction and choice and the association mechanisms extended the scope of the laboratory findings.

Contemporary Movements. The progress of psychology has been remarkable. The experimental studies were particularly enriched by the project of intelligence tests inaugurated by Binet (1905) and

the applications of psychology to the educational process, industrial problems and the understanding of social forces. The study of infant and child, together with the minute analysis of animal behavior have given COMPARATIVE PSYCHOLOGY a commanding place in the modern outlook. Clinical psychology and the study of abnormal phenomena have extended the interest in the direction of human urges. To this the contributions of Freud (*see* PSYCHOANALYSIS) have proven stimulating and by that route established a close alliance between psychology and psychiatry.

With so complete a reconstruction and extension of psychology in recent years, all that preceded becomes little more than an historical introduction, an excursion among the antecedents rather than the ancestry of what is now recognized as the comprehensive study of all phases of mental behavior and their applications. *See* PSYCHOLOGY. J. J.

See Gardner Murphy, *An Historical Introduction to Modern Psychology*, 1929.

PSYCHOMETRY, the alleged power of an object to carry an impression of its source to a psychic or sensitive medium. The term gives a name to an ancient practice of telling fate by a lock of hair or an article of clothing, which is supposed to carry the effluvia or emanation of the person. Even rocks placed upon the forehead of a sensitive person would project to the CLAIRVOYANT the actual geological scene in which the rock was formed. Thus generally psychometry is the process of conveying a mental impression by means of an object connected with it. In PSYCHICAL RESEARCH it represents a form of TELEPATHY.

PSYCHOPHYSICS, a science treating of the relation between the intensity of stimulus and its corresponding sensation, i.e., the extent to which a change in the intensity of the stimulus will make a difference in the accompanying sensation. Psychophysics is closely associated with the names of Weber (1795-1878) and Fechner (1801-87), who formulated its principles and devised its methods. It marks the beginnings of experimental psychology. *See* WEBER'S LAW; FECHNER'S LAW.

Weber found that there is a constant ratio between the intensity of a stimulus and the intensity of the sensation. This varies with the different sense organs. Thus for pressure the proportion is $1/13$ and for sound it is $1/4$. The eye is much more sensitive, responding to as slight a difference as an increase of $1/100$ in the original stimulus. If a 13-pound weight were placed on the hand it would be necessary to increase the pressure by one pound before a difference in the sensation would be noticed. In order to increase the intensity of a sensation by an arithmetical ratio it is necessary to increase the stimulus by a geometrical one. The difference between two sounds, in which the second varies less than $1/4$ in intensity from the first, will not be noticed.

Closely connected with psychophysics is the concept of the difference threshold, to find which the method of ascertaining the least perceptible differ-

ence between two sensations is utilized. Besides the difference threshold are the thresholds of minimum and maximum sensation. The method of finding the mean point between two different sensations and the method of error may also be used to discover the difference threshold.

PSYCHOSES. *See* INSANITY.

PSYCHOTHERAPY, that branch of medical science which includes the various methods of favorably influencing disease through the agency of treatment directed primarily at the mind of the patient. Tradition and very ancient historical records combine to attest to the fact, that in some form or other, psychotherapy has been utilized in the treatment of both physical and mental diseases, from the very dawn of human existence.

In order to understand scientific psychotherapy, at least two premises must be granted. The first concerns the mutual relationship and close dependence and inter-action which exist between the body and the mind. It is clear from numerous experiments and, indeed, it is a matter of common observation, that the bodily processes are influenced for weal or woe according to the favorable or unfavorable state of the emotions.

The second premise assumes that every individual has not only a conscious, but also a so-called subconscious mind. We are not clearly aware of the content of the subconscious mind, yet it unquestionably exerts a very determinative influence upon our conduct and reactions. That there is a subconsciousness, which contains, at the minimum, some residual of all our previous thoughts and experiences in life, seems to be abundantly verified by the hypnotic trance, by dream life, by behavior during delirium and under anesthesia and by many of the slips and lapses of our everyday life. It is precisely this subconscious mind which modern psychotherapy attempts to explore and, by means of the knowledge gained, to teach the patient to help himself.

Much that unconsciously passes between physician and patient is wholesome psychotherapy. Thus, an air of quiet confidence on the part of the doctor, encouragement, suggestion, persuasion, reassurance, and the ordering of cheerful and satisfactory surroundings are only a few of the psychotherapeutic measures which ameliorate illness and hasten recovery. For the sake of brevity, we may divide psychotherapy into those forms in which the patient is not asked to co-operate and which go on without his knowledge and those which he understands and to which he gives cooperation.

The following case is a fair example of the former. A lady had an hysterical palsy of the right arm. She had not been able to move it for six months. She was told that on a certain day at a certain hour she would be given a very powerful electrical treatment which would remove the disability. After the treatment she moved the arm freely. The electricity did not remove the paralysis. It was the strong, positive suggestion which brought about this result. Thus,

positive suggestion, accompanied by electricity or other devices by which the mind of the patient is directed at the removal of symptom or indirect or negative suggestion, by which the symptom is made to appear insignificant so that it finally disappears, are utilized every day in order to free patients from the symptoms of hysteria or other nervous disorders.

Hypnosis is a method of psychotherapy in which the patient submits himself to the will of the hypnotist. During the hypnotic trance the consciousness of the patient is in abeyance and the subconscious mind is open to suggestion. It is sometimes used to remove hysterical symptoms or to clear up hysterical amnesia (loss of memory). Like suggestion, hypnotism has a limited application, since neither solves the problem or conflict which is the source of the neurotic illness, but only temporarily to cause the disappearance of disabling symptoms.

Much more important are those methods of psychotherapy which entail the cooperation of the patient. In this sense, psychotherapy may be regarded as an intelligent effort to influence in the right direction the attitude of the patient—to influence his attitude toward himself; toward his mental and physical processes; toward his environment. It is an effort to teach him to understand himself; his illness and the cause or causes of his illness, whether this cause or these causes lie in his body, in his environment or in the previous experiences of his mental life.

No matter what particular method of psychotherapy is selected, it should meet the following requirements: First, the patient must have respect for and confidence in the physician and have, also, the intelligence and desire to cooperate with him. Second, the problem or conflict which is at the root of the patient's difficulties must be thoroughly understood. If it has been repressed, it must be brought to the surface of the mind or consciousness so that it may be clearly viewed and honestly faced. A special technique for accomplishing this purpose which is attracting much attention at the present time, is **PSYCHOANALYSIS**. Very briefly, psychoanalysis may be described as a method of exploring the subconscious or unconscious mind of the patient with the object of bringing to the surface or into the light of consciousness the hidden and repressed material which is the underlying cause of the symptoms. The interpretation of dream life is an important feature of psychoanalytic therapy. After the conflict has been revealed, whether by psychoanalysis or in some other way, the next step is to desensitize the patient or in other words to teach him to face frankly and honestly, the facts and experiences of his past mental life. Now the patient is ready for re-education. This consists essentially of the establishment by the patient of new habits of thinking and acting and the formulation of an adequate industrial, social, recreational and activity program of life.

E. A. S.

PTAH or **PTHA**, an ancient Egyptian god, who fashioned the universe under the direction of Thoth. He is compared to the Greek Hephaestus. (See New

CAN.) The early Egyptians grouped the gods in triads. Ptah is one of the Memphis triad which included Sekhet and I-em-hetep.

PTARMIGAN, a genus (*Lagopus*) of GROUSE highly prized as game birds, native chiefly to far northern or high mountainous regions of the Northern Hemisphere. They are 12 to 17 in. long, of compact build, with densely feathered legs and feet. Ptarmigans exhibit striking seasonal changes in color, their plumage in winter being mostly white and, at other seasons, largely brown, gray and black variously waved and barred. They feed chiefly upon buds, berries, leaves and insects and nest on the ground in low thickets, heather, or other vegetation, laying blotched, brownish eggs.



PTARMIGAN

Among New World species are the willow ptarmigan (*L. lagopus*), ranging throughout the northern portions of the Northern Hemisphere; the rock ptarmigan (*L. rupestris*), of arctic America and northern Asia, and the whitetailed ptarmigan (*L. leucurus*) of the Rocky Mountains. The red grouse (*L. scoticus*), confined to the British Isles with reddish-brown plumage the year round, is one of the most important wild birds hunted for game.

PTERIDOPHYTES, one of the four main divisions of the plant world (*Pteridophyta*), better known by their common names of ferns and fern allies. They bear no flowers but have true roots and, in most cases, well-developed leaves.

Very numerous in ancient times (there are several wholly fossil groups), the pteridophytes have dwindled to five main classes: 1. The true ferns, much the largest of existing representations. 2. The horsetails, almost leafless small herbs, which were tree-like in the Carboniferous. 3. The club-mosses, which are soft, leafy, almost moss-like woodland herbs. 4. The tropical family *Psilotaceae* which is little known. 5. The quillworts, or genus *Isoetes*, which are aquatic herbs. All but the true ferns are usually called fern allies.

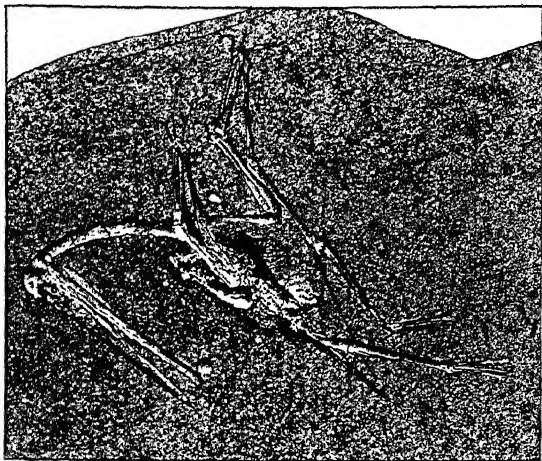
All the pteridophytes reproduce by spores, as they have no seeds. The spore never germinates directly into a new plant, but from it develops a prothallus, or functionally similar organ, upon which male and female organs grow. Fertilization, as in the mosses, can only take place when there is sufficient moisture for the male sperm to swim to the female. After conjugation the young plant, in the ferns, begins to develop and usually grows into a conspicuous leafy plant. Later this will develop spores, which are sexless, so that the mature fern plant is asexual. There are various modifications of the reproductive cycle in the fern allies, but all pteridophytes follow strictly this **ALTERNATION OF GENERATIONS**.

Pteridophytes are mostly found in temperate and

tropical regions, although a few, like some of the club-mosses are almost arctic. About 6,000 species are known, compared with 150,000 flowering plants. See FERN; HORSETAIL; CLUB-MOSS; QUILLWORT.

N. T.

PTERODACTYL, a term familiarly applied to an order of extinct flying reptiles, or "dragons," namely, the pterosaurs. This numerous group, which existed from Triassic to Cretaceous times, included the most gigantic of winged animals as well as the true pterodactyls, toothed creatures ranging in size from that of a sparrow to that of an eagle. In all



COURTESY AMER. MUS. OF NATL. HISTORY

PTERODACTYL

species the bones contain extensive air cavities and the flying mechanism consists in a thin, leathery membrane stretched between the enormously elongated outer finger and the legs and body. The free fingers were used for suspension from rocks and branches. Some species may merely have glided like flying-squirrels; other rivaled in flight the most powerful of ancient or modern birds. From the study of these bat-winged reptiles, Langley evolved his model for an airplane.

In America pterodactyls are represented by the huge, toothless, tailless *Pteranodon*, of the Kansas chalk beds, which had a wing-spread of 20 ft. and a crested skull 4 ft. long, yet weighed probably no more than a large turkey.

PTEROSAUR, any extinct flying reptile of the order, *Pterosauria*, characterized by birdlike aspect, hollow bones, and interesting modification of the forelimbs for aerial locomotion. Though they solved the problem of flight it was by means more batlike than avian, and pterosaurs are not ancestral to the birds. The earlier forms, none of which survived the Jurassic era, were uniformly toothed and had long tails. Their best known representative is *Rhamphorhynchus*, found in the lithographic limestone of Bavaria, which carried a leaflike rudder at the extremity of the tail. Cretaceous pterosaurs are characterized by short tails, and in some families by absence of teeth. They are more commonly called **PTERODACTYLS**.

PTHIA. See PTAH.

PTOLEMAIC DYNASTY, rulers of Egypt from 323-30 B.C., founded by Ptolemy Soter, son of Lagos, a Macedonian general under ALEXANDER THE GREAT, and kept full-blooded Macedonian by a practice of brother-sister marriage. The new city of Alexandria, adorned by Soter with the great museum or library, was their capital, and the greatest city of the world until long after the rise of Rome. The early Ptolemies, Soter, Philadelphus and Euergetes, erected such a firm basis for rule that their weaker successors held their independence longer than any other Hellenistic house. They were absolute rulers, like the pharaohs "descended from the gods," as well as patrons of Greek culture and consummate business men. Egypt under their guidance turned to the sea and commerce, leading the world in export trade. She was one of the three great Powers of her time, but incessant fighting with the other two, Syria and Macedonia, and with numerous petty Greek states as well, weakened all and prepared the way for Rome. Philadelphus, in 273 B.C., was the first eastern sovereign to treat with Rome; CLEOPATRA, in 30 B.C., the last to become a catspaw to the ambition of Rome's generals. After the Battle of Actium she, the last of the Ptolemies, committed suicide and Egypt became the domain of Augustus.

PTOLEMAIC SYSTEM, the older conception of the planetary system, due to Hipparchus and Claudius Ptolemy, in which the earth is placed immobile in the center of the universe, with all the other planets, the sun and the moon circling around it.

PTOLEMY, name of the Macedonian kings who ruled in Egypt from 323-30 B.C. The most distinguished of them were the first two. Ptolemy I, Soter (Saviour), was one of the generals of ALEXANDER THE GREAT. On the death of Alexander he took Egypt as his share of the newly won empire. In 321 B.C. he successfully resisted an invasion of Egypt by Perdicas, the imperial regent. Developing the power of Egypt on land and sea, Ptolemy occupied Palestine, 318 B.C., and established a protectorate over Cyprus. In 312 B.C. he defeated Demetrius Poliorcetes at Gaza. At the time of his abdication, 285 B.C., in favor of his son, Ptolemy Soter had regained Palestine after three times losing it, had retaken Cyprus, 295 B.C., which he had lost, 305 B.C., and controlled Cyrene. But he had lost all his temporary possessions in Greece of Corinth, Megara, and Sicyon, and renouncing his ambitions in Asia Minor, he had devoted himself to the internal organization of Egypt. He established a great library at Alexandria, which soon became a famous center of learning. Ptolemy II, Philadelphus (309-246 B.C.), succeeded Ptolemy Soter in 285. Attempting no further conquests by Egypt, he was nevertheless involved in a struggle with Antigonos of Macedonia, who won a victory over the Egyptian fleet at Cos, c. 257 B.C. However, in the main Egypt kept control of the Aegean. Philadelphus devoting himself to the agricultural and financial welfare of Egypt, issued statutes for the ordering of the land

and taxes, some of which are embodied in the *Revenue Laws of Philadelphus* which have come down to us. A great patron of learning, he gathered to his brilliant court at Alexandria many poets and men of science.

PTOLEMY, CLAUDIUS (c. 151 A.D.), a Greek astronomer who made his observations at Alexandria, and who was the namesake, but not certainly a relative, of the Ptolemies' rulers of Egypt after the death of Alexander the Great. The date of Claudius Ptolemy's birth is unknown, but, as his observations come down to the year A.D. 151, it is likely that he was born toward the end of the first century of our era. He carried forward the work of cataloguing the stars, at which Hipparchus had worked. He applied his observations to determine the position of 5,000 cities and towns on the map. But he is most famous as the formulator of the mathematical theory of the solar system, which held that the earth is the center of that system. He recorded his views in the book which he named *The Greatest Systematic Treatise* (*He megiste Suntaxis*), which was translated by the Arabs who called it the *Almagest*. In it he sets forth the "Ptolemaic" system, which teaches that the sun revolves around the earth, and which dominated the thought of Western astronomers until the time of Copernicus, who died in 1543. The Ptolemaic system, which completely ignored the truer view of Aristarchus of Samos and the earlier Pythagoreans like Parmenides and Philolaus, was accepted as authoritative, Giordano Bruno and Galileo being put on trial for holding views which contradicted the system of Ptolemy.

PTOMAIN POISONING. See **FOOD POISONING**.

PUBLIC DEBT. See **NATIONAL DEBT**.

PUBLIC DEFENDER. A person accused of crime is entitled by constitutional guarantee to be represented by counsel. If an individual is too poor to pay for counsel, he is in need of **LEGAL AID** service in the criminal field. This service supplies him with a **LAWYER** and a fair trial on the merits of the case without cost to himself. This service has an historical background reaching into the Middle Ages.

In the United States the service has developed in several directions. Some states make no provisions whatever; others supply a lawyer, but allow him no compensation; still others assign counsel and allow a fee from the public treasury. In its most developed form the service is known as the Public or the Voluntary Defender. Here is a permanent official or society engaged in the work of representing poor persons accused of crime.

Public Defenders exist in Los Angeles, San Francisco, Oakland, Dallas, Omaha, Minneapolis, Memphis, Chicago, Bridgeport, New Haven, Hartford and in some other cities. Voluntary Defenders exist in connection with the Legal Aid Societies in Boston, New York, Chicago and Pittsburgh. J. S. B.

BIBLIOGRAPHY.—M. C. Goldman, *The Public Defender*, 917.

PUBLIC DOMAIN. See **PUBLIC LANDS**.

PUBLIC HEALTH, in its modern aspect, the application of the discoveries of scientific medicine to the prolongation of life. Chronologically it has two divisions—the first, prior to the discovery of the *BACILLUS* (see also **BACTERIOLOGY**); the second, the period subsequent thereto. The first period covers five thousand years, the second somewhat more than fifty. In the shorter period, as a result of the discovery of the bacillus, more has been accomplished in disease eradication and life prolongation than in the previous epochs.

The discovery of the microbe led to the further discovery that it could be destroyed or made ineffective and that, as a result, certain diseases could be prevented. There is now a long list of so-called preventable or controllable diseases. Through adequate and intelligent health administration, **CHOLERA**, for example, is no longer known in the United States. **TYPHUS FEVER** is known in the United States only when it is brought there from other countries. Through adequate control of water and milk supplies, **TYPHOID FEVER** is negligible. Through immunization with toxin-antitoxin (see **ANTITOXIN**) the **DIPHTHERIA** rate is reaching zero. The mortality from this disease in New York State exclusive of New York City, has decreased over 60%. Where compulsory vaccination is in force, **SMALLPOX** is unknown, and the death rate from **TUBERCULOSIS** has been reduced one-half.

Scientific medicine is still in advance of its practical application. If the knowledge now available with respect to prevention and cure of disease were adequately availed of, the death rates from many of the preventable and controllable diseases would be reduced even further. In addition, new discoveries in scientific medicine are constantly being made. It is not long since **PNEUMONIA** was classed as a preventable disease. An antibody has been discovered which has materially reduced the lethal rate, and there is reason to believe that in the near future the means of its prevention may be found. The same is true of **INFLUENZA** and the common cold. Published investigations indicate strongly the likelihood that the causes of these two diseases may be found and that with the discovery of the causes may follow the means of prevention. Even **CANCER** may eventually be included in this category.

The effect of all this has been pronounced. In 1901 the expectation of life in the original registration states was 49.24 years; in 1927 it was 59.35 years. In Massachusetts between 1878 and 1882 the expectation of life for males was 41.74 years and for females 43.50; in 1924 this expectation had increased for males to 56.67 and for females to 60.09 years. Contrasted with these figures are the expectation of life in India, which in the decade 1881 to 1891 was 25.07 years, and between 1901 and 1911 was 22.95 years. The differences are in part due to the high infant death rate which still prevails in India, and to the lack of adequate administrative health procedures.

It has been said that within limits every community

can determine its own death rate. Such determination depends upon the ability of the community to make adequate expenditures. In some communities until recently the average annual expenditure for health purposes was only \$50 per capita, while many modern communities are today expending an average of \$2.00 per capita. With adequate outlay and the utilization of every phase of scientific discovery, more of the so-called transmissible diseases will entirely disappear and other diseases will be markedly reduced in extent.

It may safely be said that the adequate utilization of existing medical knowledge, with the further reduction in infant diseases and death rates and with the further elimination of transmissible diseases, may increase the expectation of life to 65 years and possibly to 70 years. It may be, however, that the newer research with respect to HORMONES and the ENDOCRINES GLANDS, together with the additional studies in the field of nutrition, may produce new data enabling an expectation of life of beyond 70 years. *See also* EPIDEMIOLOGY; ENTOMOLOGY, MEDICAL; IMMUNITY; SANITARY ENGINEERING; WATER PURIFICATION.

L. K. F.

PUBLIC HEALTH SERVICE. *See* QUARANTINE.

PUBLIC INTEREST. In *Munn vs. Illinois*, 94 U.S. 113, the Supreme Court of the United States declared that property becomes clothed with a public interest when used in a manner to make it of public consequence and affect the community at large. A business which franchise privileges is clothed with a public interest which places it under legislative control.

Businesses which affect public interest are not confined to what are known as public service corporations, hence, it must be the peculiar way in which the public is affected that places particular enterprises in the category of public utilities. Certain kinds of undertakings affect the public in a manner different from others, which demand different treatment. One characteristic of such a group is the special use of public property. Owing to special need, the enterprise is clothed with the right of eminent domain, that is, the right to seize private property, upon just compensation, for public use. Another peculiarity of the enterprise clothed with a public interest is the holding out of its readiness to serve without discrimination all who apply.

No individual is compelled by law to devote his property to public use, but if it is so devoted it becomes of public interest which subjects it to public control for the common good. Constitutional and common law rights are held inviolate. The nature of the service rendered or the product served determines its legal status.

Public regulation not only embraces the nature of the service rendered, but also the charges imposed. Both the common law, as shown by the early English cases, and statutory law declare that the company engaged in public service must limit itself to a

reasonable compensation. It is a legislative prerogative to determine what shall be reasonable compensation, but in the absence of legislative enactment the courts must determine what is reasonable. *See also* PUBLIC UTILITY.

T. C. J.

PUBLIC LANDS, tracts of land which have been acquired by the United States in every state and territory of the Union, excepting the original 13. Originally sold to settlers as a source of revenue to the Federal Government, they became the basis of the homestead idea to attract a high type of immigrant after 1820, when the need of revenue for payment of the national debt decreased. The first homestead law, passed in 1862, provided that any citizen, the head of a family, or 21 years of age, or who had served not less than 14 days in the U.S. Army or Navy during an actual war, might apply for 160 acres or less of unappropriated public lands by cultivating it for 5 years immediately following, and paying all fees necessary to cover the cost of administration. These homesteads were exempted from seizure for any debt contracted prior to the date the patent was issued to the holder. This provision was incorporated in all later homestead laws. Since the World War, ex-service men have been granted homestead privileges similar to those conferred upon veterans of the Civil and Spanish wars, and, in addition, a preference over the general public in the selection of unappropriated public lands. In the meantime, the period of residence necessary to perfect a homestead title was reduced from 5 years to 3 in accordance with an act passed on June 6, 1912.

On July 1, 1930, the remaining public lands, subject to disposition under applicable land laws, was 178,979,446 acres, of which 128,301,266 acres were surveyed and 50,678,180 acres unsurveyed. Such areas were distributed among the several states as indicated in the following table:

	Surveyed	Unsurveyed	Total
Arizona	8,084,880	7,096,000	15,180,880
Arkansas . .	190,969		190,969
California	11,284,395	5,339,093	16,623,488
Colorado	6,825,425	1,202,043	8,027,468
Florida . . .	12,245	6,652	18,897
Idaho	8,765,491	1,852,479	10,617,970
Minnesota . .	189,845		189,845
Montana	6,510,937	90,740	6,601,677
Nebraska . . .	22,628		22,628
Nevada	30,064,688	21,389,805	51,454,493
New Mexico . .	14,316,481	1,347,640	15,664,121
North Dakota .	146,505		146,505
Oregon	12,976,725	92,411	13,069,136
South Dakota	439,880		439,880
Utah	12,378,068	11,503,377	23,881,445
Washington	906,382	14,202	920,584
Wyoming . . .	15,185,722	743,738	15,929,460
Grand Total . .	128,301,266	50,678,180	178,979,446

PUBLIC OWNERSHIP. The movement toward public ownership of important industries has advanced steadily during the last few generations. The largest of industries, that of transportation and communication, is steadily and increasingly throughout the

civilized world passing into one or the other form of governmental organization. Only in a few backward countries such as Abyssinia, Afghanistan and Arabia is mail still delivered by private agencies. The telephone and telegraph services are owned in whole or in large part by national and municipal governments in nearly every advanced industrial country outside of the United States, Brazil and Spain.

Out of nearly 70 large and small countries having railroads there are about 50 in which government administration prevails, either wholly or with slight exceptions. In this connection, however, it must be said that the United States and the United Kingdom, in which private ownership prevails, account for the majority of the railway capital of the world. Governments have also been of enormous indirect assistance to water and land transportation. They have built and maintained canals, embankments, ports, docks and wharves, have conducted the immensely valuable lighthouse and coastal services and have constructed and widened, paved, cleaned and lighted existing roads.

An astonishing increase in community operation has also taken place in the municipal tramway service. From 1860 down to nearly the end of the 19th century, street car systems were largely left to private owners. Since then this public enterprise has taken a leap forward and these services in most of the European countries have become predominantly public.

Nearly the whole activity of school education has within a century, passed from being for the most part a profit-making venture to a service conducted almost entirely by the community. Public hospitals, medical schools, day nurseries and public insurance systems have brought an ever larger number of physicians into the service of the community. Perhaps a majority of medical practitioners are now in government pay in one or another form. Most industrialized countries have systems of social insurance to safeguard workers. Many governments have become the principal bankers in their respective communities. Extensive public forest reserves exist in the United States, Germany, Russia, Japan, France and other lands. Governments have extensively undertaken mining.

Water is supplied by public agencies in most cities of the United States and abroad. Various public bodies own a major part of the German electrical industry, while gas and electricity are owned by municipalities in a large number or a majority of cities in Europe. In the United States may be found more than 100 municipal gas plants and over 2,000 municipal electric light plants, though mostly in the smaller cities.

In Russia, which occupies one-sixth of the earth's surface, natural resources, public utilities, banks and manufacturing industries are owned by the government. In general, outside of Russia, there is scarcely a craft or service that is not somewhere carried on by one or more local or federal governments.

State and municipal administration has been most highly developed, and has proved to be most strik-

ingly developed in communication and transportation, land improvement, sanitation and public health, education and recreation, the extraction of other minerals and insurance and banking. Since the World War, great strides have been made particularly in public electrical development and in municipal housing, particularly in Germany and Austria. Vienna presents a striking example among western European nations of the extent to which municipal socialism may go.

H. W. L.

PUBLIC SAFETY, COMMITTEE OF, in French history a committee established by a decree of the National Convention on Apr. 6, 1793 as a ministry of nine deputies responsible to the Convention. Through changes in the personnel and the multiplication of its powers and duties the original character as a superior executive board, deliberating in secret and disposing funds for secret expenses, was greatly extended. Although in principle the National Convention remained the sole center of Governmental activities and although the Committee of Public Safety shared its powers with another powerful committee, the Committee of General Security, the Committee of Public Safety was in fact recognized as the supreme force of the state. From Sept. 1793 until the fall of Robespierre on the 9th Thermidor, July 1794, its membership remained virtually intact, the members being reelected every month. It became the real dictatorial body of the new Government, having the right of supervision over the ministry, the generals, public functionaries and the other Governmental committees. After the overthrow of the Robespierrists the Committee of Public Safety lost its primacy, retaining control only of diplomacy and military operations.

PUBLIC SCHOOLS. This term has totally different meanings in the United States and England. It is applied in the United States to those institutions maintained, at public expense and under the control or supervision of some body or group representing the public, to provide facilities for the instruction and education of its citizens, young and old. Generally higher education in institutions of college and university rank are not included even though they may be publicly supported. In England the term public school refers to a limited number of private fee-paying secondary schools administered by boards of governors and not run for private profit. Traditionally the name was applied to nine great public schools: Eton, Harrow, Winchester, Shrewsbury, Westminster, Charterhouse, Rugby, St. Paul's and Merchant Taylor's, but is now used of some 200 schools, which have adopted some of the main characteristics of the older schools. The equivalent of the term is found in other languages, e.g. *école publique*, *escuela publica*, *Volkschule*, but it is applied only to elementary schools for the masses.

Compulsory Education. Public school systems are the creation of the 19th century, although the social importance of education has always been recognized. The Jews from their earliest history imposed upon parents the duty of educating their children.

Among the Greeks compulsory education was found among the Spartans. The Romans did not require compulsory education, but rhetoric schools maintained at public expense appeared early in the Empire. In the medieval period parish priests were frequently enjoined to open schools. Compulsory education, however, out of which the public provision of schools developed, began to be urged by the educational leaders of the Reformation, Luther and Calvin. Thus the first compulsory attendance law was passed in Weimar in 1619, and a similar law was enacted by Duke Ernest the Pious for Saxe-Gotha in 1642. The establishment of parish schools at the expense of the parishioners, an idea urged in 1560 by John Knox, was enacted in Scotland in 1633. The Synod of Dort in 1618-19 advocated the provision of schools with free tuition of the poor and, although it had little effect in Europe, played an important part in the development of schools in New England. Thus in Massachusetts in 1642 the selectmen were required to compel parents and masters to have their children or apprentices taught to read and to understand the capital laws of the country, a provision supplemented in 1647 by the requirement that towns of 50 householders appoint teachers of reading and writing to be paid by fees or rate levies and that towns of 100 householders appoint teachers of Latin. But as time went on it was found difficult for a variety of reasons to enforce these laws.

The movement for the provision of schools at public expense in the United States really began in the period of the Revolution. It was influenced not by religious considerations but by a recognition of the implications of political independence and liberty, by the ideals of the French theorists of the Revolution, and a little later by practices already developed in Germany. The acceptance of the principle of education at public expense was not a simple matter. It needed the cooperation of statesmen, of organizations of farmers, mechanics and workingmen, of societies for the improvement of education, and the active propaganda of a group of educators like HENRY BARNARD, HORACE MANN and many others to direct public attention to the need. It was only with the fuller recognition of the meaning of democracy and the spread of the notion of egalitarianism that the programs for public education were slowly adopted. Strong opposition had to be overcome, some directed against taxation for education, some against free education for any but the poor, some against the establishment of the public school on a non-sectarian basis, and some against interference with the right to local self-determination.

The first compulsory school attendance law was passed in Massachusetts in 1852. At this period the term common school rather than public school was generally employed. Until the decision was handed down in the *Kalamazoo Case*, 1874, it was also assumed that the common school referred only to the elementary school. This decision made it clear that where common schools were required to be provided

at public expense, education beyond the elementary could be included. The consequence of this decision was the beginning of the increase of public high schools throughout the country. The first public high school had been established in Boston in 1821. For the first time there was realized in the United States the definition of the public school by George S. Bontwill, Secretary of the Massachusetts Board of Education, "A public school I understand to be a school established by the public, supported chiefly or entirely by the public, controlled by the public, and accessible to the public upon terms of equality, without special charge for tuition."

Public Responsibility. The acceptance by the public of the responsibility of providing education at public expense has been carried further in the United States than elsewhere. It has involved the enactment of compulsory attendance, now universal from the age of 6 up to the age of 14 and in some states up to 16, and of child labor laws. It implies legislation on the length of the school year, which is not yet universally satisfactory in all states. It has meant the provision of free textbooks and supplies which is also not yet universal, especially in the South. In order to insure the best conditions for the conduct of the schools, buildings have been improved, the preparation and qualifications of teachers have been gradually raised, and provision has been made for the care of the health of pupils through medical inspection. Public responsibility, however, does not end with the provision of the best material conditions for education. For the younger children kindergartens have been established. In the rural areas consolidation of schools and transportation have been introduced. In all elementary schools much thought has been devoted to the improvement of methods, curriculum and courses of study, as well as of systems of promotion. For those handicapped mentally, physically or morally, special arrangements have been made in special schools. The outstanding characteristic of American education, however, has been the extensive provision of educational opportunities through the free high school. Here, too, the unparalleled increase in the enrollments since 1900 has necessitated the recognition of individual differences and of the need of adapting the work to a variety of aptitudes and capacities. The United States has not yet adopted the practice of some other countries of providing maintenance grants for poor but able pupils. In order better to articulate elementary and secondary education, the traditional organization of eight years of the former followed by four years of the latter is giving way slowly to six years of each with a further extension upward in some places to include the JUNIOR COLLEGE. Beside the high school there also exist for those who have completed the elementary schools part-time CONTINUATION SCHOOLS, trade schools, EVENING SCHOOLS, and a variety of opportunities for the education of adults. (See ADULT EDUCATION.) Finally, in order to link the school and the home more closely together PARENT-TEACHER ASSOCIATIONS are spreading rapidly.

England, France and Germany. While public education is provided in all countries, it has hitherto been distinguished from the American in being based on class distinctions, the elementary schools or public schools being intended for the masses and secondary schools for those who can pay the fees or who win free tuition by their ability. Other types of schools beyond the elementary exist for special types of education. There is, however, a progressive movement to increase educational opportunities and to develop a common school system: the *Einheitsschule* in Germany, the *école unique* in France, and secondary education for all in England. While relatively little progress has been made in this direction in Germany, France has begun to abolish fees in her secondary schools, and in England nearly half of the pupils in the public secondary schools created since 1902 enjoy free tuition. A bill to extend compulsory education to 15 and to provide some form of post-elementary education for all after the age of 11 passed in the House of Commons in Jan. 1931, but was defeated in the House of Lords. As compared with the United States the leading countries abroad, especially England and Germany, make better provision for very young children and for social services in the schools. See EDUCATION, NATIONAL SYSTEMS OF; UNITED STATES, EDUCATIONAL STATISTICS; AGRICULTURAL EDUCATION; INDUSTRIAL EDUCATION. I. L. K.

BIBLIOGRAPHY.—E. H. Reisner, *The Evolution of the Common School*, 1930, E. P. Cubberley, *History of Education*, 1920; and *Public Education in the United States*, 1919; I. L. Kandel, *History of Secondary Education*, 1930, I. L. Kandel, editor, *Educational Yearbooks of the International Institute of Teachers College*, Columbia University, 1925-; *Public Schools Yearbook*.

PUBLIC SERVICE, a service in which the community has, or may be presumed to have, a common interest. It is offered to the public generally or to a defined portion of it.

Although the term Public Service has been used in a number of ways, its use in connection with public service corporations is most frequent. It is the primary duty of a public utility to give reasonable, adequate and non-discriminatory service at reasonable rates and without delay to the general public. It cannot refuse to serve one person in favor of another nor extend privileges to one and not the other.

The devotion of property by the owner to public use carries with it the duty to serve the public. (See PUBLIC INTEREST.) Usually the public utility, except with the consent of the state, may not perform acts which make it unable to discharge its public duties. This requirement is enforced even though the service is being rendered at a loss. A utility, however, is not bound to continue service, in the absence of voluntary contract, if there is no reasonable prospect of operating profits in the future. But at times a utility may be required to perform indefinitely a service at a loss, provided other parts of the system are operated at a profit. In the absence of an adequate excuse for nonperformance, a public utility may be compelled to continue operations. It may be re-

strained from committing an *ultra vires* act if such act would impair its ability properly to serve the public.

Under certain circumstances a utility may be permitted to abandon its service. In such cases, however, it is necessary either to receive the permission of the state or make it a party to proceedings initiated for the purpose of obtaining permission for abandonment. T. C. J.

PUBLIC UTILITIES, enterprises organized under special privilege to provide services or products which are considered essential to the public welfare and the provision of which is regarded a public function. The term embraces all property devoted to public use and in which the public has an interest. (See PUBLIC INTEREST.) The enterprises commonly comprising the list are electric light and power, gas, street railway, telephone, telegraph, water, heating, warehouse and storage, refrigerating, sewerage, bridge, wharf, turnpike, express, sleeping car and ice companies, concerns which transport oil and gas by pipe lines, and in the South, cotton gins. In addition to the foregoing, the railroads may be classed as the premier public utility, but because of their magnitude and early development, they are usually classed by themselves.

Public utilities are either natural or licensed monopolies. They enjoy the use of public property usually to the exclusion of competitors. Hence, it becomes necessary to substitute public regulation for private competition. State and Federal governments have enacted laws and created commissions for the regulation of utilities.

The contract between the public and the utilities, in addition to constitutional and statutory provisions, is embodied in the franchise. It expresses the privileges and obligations of the public service corporation. The mutuality of the undertaking, as evidenced by the terms of the franchise, should assure adequate service at reasonable cost to the public and a fair return to the investor. The most desirable type of contract, under present public service commission control, is the indeterminate franchise which reserves to the government the power of revocation whenever the utility fails to render adequate service at just and reasonable rates. The corollary to the company is flexibility of rates and service standards as changing conditions warrant. Under this type of franchise the utility is regarded as a continuous enterprise which is serving the public in an efficient and economical manner.

Competition among utilities is no longer regarded as conducive to increased efficiency at lower costs to the customer. There is a growing conviction that they are monopolistic in nature and should not be subjected to competition, but to regulation. As a result of this conviction, the state has imposed regulatory measures controlling rates, service, capitalization and accounting and reports of the utilities. Aside from the general laws which provide the skeleton of the regulatory standards, the Public Service Com-

mission, as a special representative of the public, constitutes the supervisory and regulatory body empowered to prescribe the complete fulfillment of franchise obligations.

Commissions experience considerable difficulty in fixing rates sufficient for all operating costs, governmental charges, a fair return on the capital and a sum sufficient for contingencies, but rates which are not at the same time excessive when compared with the charges of other companies under similar conditions. Rates should be sufficient to attract new capital, i.e., a return on capital equal to what it could get elsewhere under similar conditions.

The problem of rates involves that of valuation. Private property is protected by the fifth amendment to the Federal Constitution which provides that "No person shall be . . . deprived of life, liberty or property without due process of the law; nor shall private property be taken for public use, without just compensation." The minimum limitation, in the absence of voluntary agreement to the contrary, is a fair return, otherwise the utility may appeal to the courts for relief against confiscation. The United States Supreme Court has permitted various rates, but rates ranging between 7 and 8% of the value of the property devoted to public service predominate.

Commissions are interested in the proportion of bonds, preferred stock and common stock. A capital structure having an excessive amount of bonds with their fixed charges is a constant burden to a company and may result in failure during a period when earnings are insufficient for the debt service. Involuntary reorganization in such an event would follow. Regulatory bodies are primarily interested in the service rendered, but inasmuch as an unbalanced capital structure is a burden to the company, often impairing its credit and possibly precipitating bankruptcy, its capitalization is carefully supervised.

Reliable data are essential to intelligent regulation. For this reason the commissions prescribe the accounting system and the nature of reports to be rendered. The investor is provided with uniform statements presented with considerable clearness which enable him to analyze the investment merits of the various companies. Concentration of control is being accomplished through the formation of large holding companies which control through a comparatively small investment a large group of operating companies. Holding companies are not considered public utilities and are not therefore subject to commission control. See also PUBLIC SERVICE T. C. J.

PUBLIC UTILITIES, LAWS CONCERNING.

In medieval times, the law governing most of the common types of business enterprise was what we should to-day call public utilities law, in that persons regularly engaged in such enterprises were under a legal duty to charge only reasonable prices, and to furnish goods or services to any person able and willing to pay them. By the beginning of the 19th century, however, a growing belief in the desirability of freedom of contract had swept away most of this

early law, leaving the common carrier and the innkeeper alone subject to these public utility duties.

The development, during the last century, of large scale enterprises, often monopolistic in character, on which the public is obliged to depend for such necessities of modern life as gas and electricity, has brought about a reaction from this theory of business freedom; and either by legislation or judicial decision, many important types of business have recently been declared to be public utilities. The Supreme Court of the United States has held that public utility duties cannot consistently be imposed upon any business unless it is "affected with a public interest." The meaning of that phrase is rather obscure but some light is furnished by decisions that neither the highly competitive business of furnishing gasoline, nor the non-essential services rendered by a theater ticket agency can be subject to price regulation.

In addition to extending public utility duties to new types of business enterprises, modern conditions have led to important developments in the duties imposed upon utilities. To the rule that rates must not be unreasonably high has been added the rule that all persons receiving similar service must be charged the same rate. Furthermore, the utility must be equipped with proper facilities to furnish adequate service.

To enforce these legal duties, Congress and most of the states have established administrative commissions, the most important of which is the Federal Interstate Commerce Commission (*see* INTERSTATE COMMERCE ACT AND COMMISSION), which regulates the activities of interstate railroads and certain other interstate utilities. This commission was created by the Interstate Commerce Act of 1887, and has been granted important additional powers by later acts of Congress. These acts provide that every interstate railroad must file with the commission a schedule of its rates, and that these rates, unless set aside by the commission, must thereafter be exacted from every shipper. The commission has power to set aside any rate which it finds to be unreasonable or to discriminate unjustly against any person or community and in such event to prescribe a different rate. To aid it in determining the reasonableness of rates, it is required to ascertain the value of all property used in the railroad business. The commission is also empowered to require railroads to provide themselves with adequate facilities, to compel physical connections between and through rates over adjoining lines, and to order extensions of lines. No new line may be built nor any existing line abandoned without its consent. In 1920 it was given the additional functions of regulating the issue of all railroad securities and of working out a plan for consolidating the railroads of the country into a limited number of systems.

Most of the states have established utility commissions with powers resembling those of the Interstate Commerce Commission, such differences as exist between the state and the federal commissions being in large measure due to the different kinds of en-

terprises regulated by each. These state commissions have certain powers over the purely intrastate business of railroads; but their principal function is to regulate such local utilities as street railroads, gas and electric companies, local bus lines and the intrastate activities of telegraph and telephone companies. Control of local utilities is frequently exercised by municipalities, either through their power to grant franchises for use of city streets or by legislative delegation of regulatory power to cities. The present trend is toward making such local control subject to revision by a state commission.

Broad as are the powers of the commissions, they are subject to important constitutional restrictions, especially with respect to rate fixing. Rates must be high enough to enable the utility to earn a reasonable return upon its property. How such property should be valued has been for years a subject of controversy between the utilities which have insisted upon reproduction cost as the principal factor, and the commissions which have tended to favor actual cost in cases where such cost has not been needlessly extravagant. Recent decisions of the United States Supreme Court have displayed a strong leaning toward the reproduction cost theory, a victory for the utilities which falling prices may give them cause to regret.

The law of PUBLIC UTILITIES is developing so rapidly that treatises on the subject soon become antiquated. Wyman on *Public Service Corporations* (1911), the most comprehensive work on the subject, is already out of date. Pond on *Public Utilities* (third edition 1925), the most recent work, is of limited scope. An adequate presentation of many of the modern legal problems is to be found only in articles in the leading law reviews.

E. M. D.

PUBLIC WELFARE, an economic activity which began to assume major proportions of government in the United States early in the 20th century. It was the technical social work part of government or "public social work." This applied to national, state, county and city governments. Its rise from the early days of the National Conference of Charities and Corrections in 1879 indicated its social origin while its later development since 1917 indicated its complete adoption by government. The public welfare movement was accompanied, in general, by three period features. From 1879 to 1900 there were general discussions and studies; from 1900 to 1917 specialization began; from 1917 to 1930 was a period of actual legislation and organization, more than 40 states having some definite state department or board, with nearly half using the name public welfare or social welfare, as the chief designation. Public welfare has retained its social significance in that it has adopted the best methods of social work and attempts to embody the social principles and practices of democracy; it has assumed governmental character by conforming to the changing demands of public administration.

On the social side the chief development has been a complete change in the underlying philosophy

and practice of public welfare. From the original concepts of charity and condescension have developed the larger concepts of public welfare and rehabilitation. This trend is indicated in the almost complete renaming of departments and the substitution of such terms as welfare, social welfare, public welfare, penology, schools and hospitals, for the old terms of charity, correction, lunacy, asylums and reformatories.

On the administrative side the chief trend has been reflected in the development of public welfare from incidental, irregular and extra-governmental organizational functions, to full-fledged, regular integrated organic and standard functions of democratic government. In other words, public welfare organization has come to be an assumed fundamental part of government in the eyes of the citizen, the student, the professional worker and the politician. And in the sweeping reorganizations of state governments, public welfare has taken a major place. Similar transformations have been taking place in municipal governments while state supervision of county and other local welfare work has assumed major proportions.

Major trends, growing out of these developments, other than those in general philosophy and terminology, include those in the specialization of administrative functions, in general administration, in institutional organization and technique, in the centralization of control and policy with its accompanying departmentalism and bureaucracy, in increase in research and scientific sanction for organization, in increase in state aid to local groups, together with intensive changes in special fields, such as institutional architecture, the staffing of institutions, interstate relations, classification, penal, medical, educational, and other rehabilitative services such as probation, parole, mothers' aid, old age relief and social legislation.

H. W. O.

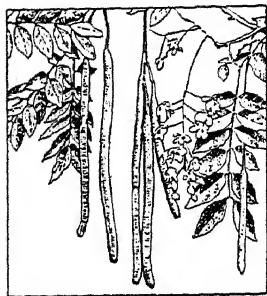
PUCCINI, GIACOMO (1858-1924), Italian opera composer, was born at Lucca, June 22, 1858. His family had been musicians at Lucca for four generations. Puccini studied at Milan under PONIHELLE, supporting himself by means of a pension from the Queen of Italy. *Le Villi*, his first opera, was composed for a music competition, and it was totally ignored until Borro, recognizing its merit, made possible its production at Milan in 1884. *Manon Lescaut* in 1893 and *La Bohème* in 1896 made a favorable impression, exceeded in 1900 by the immense success of *Tosca*, produced at the Teatro Costanze, Rome. *Madame Butterfly*, produced in 1904, was received with hostility, although it slowly grew in popular esteem. In *The Girl of the Golden West* Puccini made an ambitious effort to modernize his technique, and used as plot the play by David Belasco. *La Rondine*, produced in 1917, enjoyed moderate success. The composer's works gradually became popular with nearly all classes of music-lovers. His operas generally employed the traditional melodic construction of Italian composers, somewhat modernized, but his firm grasp of dramatic values saved him from the banalities of

some of his Italian predecessors. *Turandot* was almost completed when Puccini died, at Brussels, Nov. 29, 1924.

PUCCOON, the North American Indian name for a number of plants with colored juices suitable for war paint or dyeing purposes. Among them are the bloodroot (*Sanguinaria canadensis*), known as the red puccoon, and the various species of *Lithospermum*, as the hoary puccoon (*L. canescens*), the hairy puccoon (*L. Gmelini*) and the narrow-leaved puccoon (*L. angustifolium*). The name yellow puccoon was sometimes applied to the golden seal (*Hydrastis canadensis*), a valuable medicinal plant.

PUCK, in English folklore, a mischievous elf or goblin, also known as **ROBIN GOODFELLOW**. In Shakespeare's *Midsummer Night's Dream*, he appears as a merry night-prowler, a spirit of mischief, "faun-faced and shock-pated," who delights in tricking fairies and mortals.

PUDDING-PIPE TREE (*Cassia Fistula*), a tree of the pea family grown in the South as an ornamental and furnishing the cassia pods of commerce, used medicinally. It is a native of India naturalized in the West Indies and other tropical countries. The tree bears large pinnately divided leaves, pale yellow flowers in loose drooping clusters, a foot or more long, and black cylindrical fruits, 1 to 2 ft. in length, containing a laxative pulp.



PUDDING-PIPE TREE

PUDDINGS, sweet foods, usually of soft consistence. They are generally boiled or steamed, more rarely baked. Cake-like puddings, such as cobbler, cottage and steamed puddings are served hot. Tapioca puddings, custards, and gelatin desserts, like Bavarians, sponges, jellies, etc., are served cold. Puddings are often served with a sweet or tart sauce. Suet pudding is a mixture of flour, beef suet, sour milk and molasses, with spices and sometimes raisins steamed for about three hours.

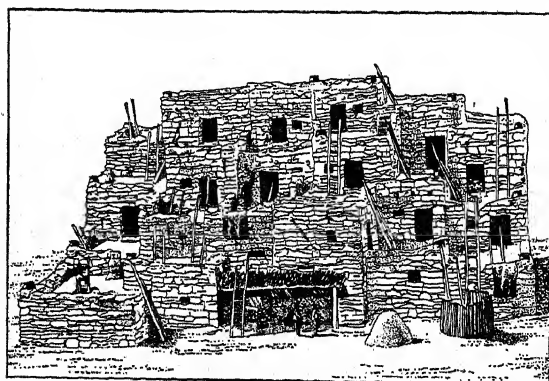
PUEBLA, a state of Mexico, situated on the extreme southern slope of the great central plateau, with an area of 12,992 sq. mi., and a mean altitude of 7,000 ft. Its surface is broken by some of the most important and well-known mountains of Mexico, among which are the volcanoes of Popocatepetl, Cofre de Perote and Iztaccihuatl. The climate is variable, with a cold temperature in the mountains, and tropical in the lowlands. The most important river is the Necaxa, which has some magnificent falls which are used to supply electric power for Mexico City. The soil of the valleys is fertile and suited to many kinds of agriculture, the chief products being wheat, sugar and cotton. Many of the souvenirs found in that part of the country are made from a transparent onyx found in Puebla. The capital is Puebla and other towns are Zacatlan, Tehuacan, Cuetzlan and Cholula,

noted for the pyramid of Cholula. Pop. 1921, 1,024,955; 1930, 1,148,286.

PUEBLA, a city of Mexico, and capital of the state of the same name, situated at an altitude of 7,200 ft. above sea level, about 130 mi. southeast of Mexico City. It is an important commercial center, the third largest city in the republic, and is well-built with houses several stories high. It has a brisk trade in marble and tiles and is the textile center of Mexico. Among its industries are about 40 cotton mills, many large wholesale houses and a good retail trade. It is noted for the manufacture of the famous Talavera ware first made in Spain. It has modern public schools, a normal school, a theological seminary and schools of medicine and art. There are two libraries, several hospitals, a museum of antiquities, built in 1728, and many churches. The Doric cathedral stands on the main plaza, and has valuable pictures and attractive decorations. One of the many attractions of the surrounding district is the pyramid of Cholula, similar to the pyramids of Egypt. It was discovered by the Aztecs in 1176 upon their arrival in Mexico.

Puebla was founded in 1532, and from a military standpoint has always been the key to the capital city. It fell to Iturbide in 1821, and was the scene of several battles led by Porfirio Diaz and Ignacio Zaragoza against the French. Two of these battles, on Apr. 2, 1867, and May 5, 1862, are commemorated by national holidays. It was also captured by Gen. Scott in 1847. Pop. 1921, 95,535; 1930, 121,289.

PUEBLO, a Spanish word meaning town, especially applied to the communal villages characteristic of the Indians of Arizona, New Mexico and adjoining regions. A pueblo consists of a building or group of buildings and frequently houses a whole tribe. The buildings are made of adobe or sun-dried brick with a straw binder and are from two to five stories high.



COURTESY AMER. MUS. OF NATL. HISTORY

PUEBLO OF THE HOPI INDIANS
From a model by Ned J. Burns

Each story is "stepped back," forming a terrace. There are neither doors nor windows in the first story. The pueblo dwellers ascend to the top of the first story by means of ladders which can be drawn up in case of danger and enter their homes by trap doors and descending ladders. Frequently a pueblo is built around

three sides of a court. The Hopi village of Oraibi in New Mexico and the Zuni village in Arizona are famous pueblos.

PUEBLO, a city in southern Colorado, the county seat of Pueblo Co., situated on the Arkansas River, 120 mi. south of Denver. Transportation facilities include four railroads, bus lines and a municipally-owned airport. Situated at an altitude of 4,685 ft., in a valley where the prairies meet the foothills of the Rockies, Pueblo has an excellent climate, attractive to winter tourists, and is near magnificent scenery, including the San Isabel National Forest. The principal crops of this district include sugar beets, garden truck, alfalfa, corn and flower, fruit and garden seeds. Among the leading manufactures are iron and steel. The value of manufactured products in 1929 was about \$20,000,000; in 1929 the retail trade amounted to \$27,772,389.

Pueblo was first settled by Mexicans. The settlement was on the original Oregon and Santa Fé trails. Many of the Mormons in 1845-46 made it a stopping-off place on their way to Utah. The town was nearly wiped out by the Indians at various times, but finally became established as a trading post in 1850. Kit Carson made his headquarters here. Pueblo was chartered as a city in 1870 and received a new charter in 1887. Pop. 1920, 43,050; 1930, 50,096.

PUERPERAL FEVER, a term referring to fever occurring in women at the time of or more usually immediately after the birth of a child, known also as puerperal sepsis, puerperal septicemia, child-bed fever and lying-in fever. It was discovered by Semmelweis, that the cause is an infection generally resulting from contamination at the time of confinement. Infection is usually, but not always, preventable; in most instances it is due to lack of proper care on the part of the physician, nurse or midwife, in other cases no individual is at fault. Lowered resistance of the patient plays a large part and women who have lost a great deal of blood, or who have had long, hard, instrumental deliveries, or those who have had a poisoning such as ECLAMPSIA are more susceptible to puerperal fever. Likewise, in a certain proportion of cases, even when there is no attendant around at the time of confinement, a woman may develop child-bed fever. These are usually cases of so-called endogenous infection, where there are within the patient's body bacteria which produce the infection after the baby is born. This type of infection is distinct from infection due to external contamination. There are numerous pathogenic or disease-producing organisms which produce puerperal sepsis, but the most common bacteria are the streptococcus, staphylococcus, and the *Bacillus coli*.

Puerperal fever varies considerably in degree. There are mild cases in which recovery is the rule and seriously ill women in whom recovery is the exception. In the United States alone of the 20,000 women who die every year as the result of childbirth, almost 8,000 die from puerperal sepsis. Many of these deaths are preventable. Proper asepsis and antisepsis at the time

of childbirth and skill on the part of the attending physician can reduce this number tremendously. In mild cases there are usually moderate fever, a foul discharge from the uterus, sometimes mild bleeding from this organ, pain in the abdomen, headaches and other symptoms. In the severe cases there is pallor, anemia, high fever every afternoon and evening, with marked lowering of the temperature in the morning, a foul odor to the uterine discharge, decided prostration, pain in the abdomen, occasionally nausea and vomiting, and other symptoms.

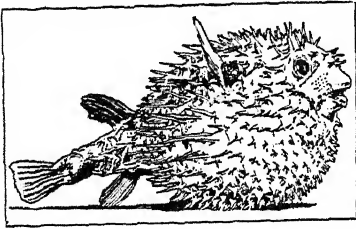
There is no specific treatment for these cases, although many forms of therapy have been recommended. An attempt is made to build up the resistance of the woman by means of fresh air, nourishing food, tonics, and occasionally small blood transfusions. An operation is seldom indicated unless there is an accumulation of pus, when the abscess is opened and drained. If peritonitis develops, an operation may occasionally help. See also MATERNAL AND INFANT WELFARE; OBSTETRICS. J. P. G.

PUFFBALL, the name given to a genus (*Lycoperdon*) of large, fleshy, mostly globular or pear-shaped fungi allied to the mushrooms. Upon attaining full size the fleshy interior is solid and white, but as the spores are formed becomes yellowish and dries up when they ripen, breaking down into a powdery substance, which, like the spores, is exceedingly light. Upon the slightest pressure this substance together with the spores is discharged in small smokelike clouds through openings in the wall, whence the common name puffball or, as they are styled in the South, devil's-snuffbox. There are numerous species most of which, when white and fleshy, are edible. The giant puffball (*L. giganteum*), common in grassy places in late summer and autumn, is the largest species known. It is usually 8 to 16 in. across but sometimes grows 3 or even 4 ft. in diameter. Among the common, but much smaller, edible species are the gemmed puffball (*L. gemmatum*) and the pear-shaped puffball (*L. pyriforme*). By some authorities the genus *Lycoperdon* has been divided into several genera.

PUFF BIRD, one of a family (*Bucconidae*), of small New World birds allied to the jacamars, so called from their habit of perching motionless with the plumage of the head ruffled until it looks like a puffball. There are about 45 species, ranging from Guatemala and Honduras to Argentina. They differ from the jacamars chiefly in their shorter, stouter bills, hooked or incurved at the tip, and in their very large heads. Their plumage is black, brown or chestnut relieved by various white markings. Solitary in habit, puff birds frequent trees, usually in forests, but sometimes around habitations, where they are very tame. They feed on insects which they capture by swift darts from a fixed perch. Little is known regarding their nesting habits.

PUFFER, a name often given to the members of a numerous group (*Gymnodontes*) of spiny-rayed fishes, including the swellfishes (*Tetraodontidae*) and

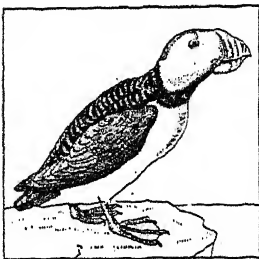
the porcupine fishes (*Diodontidae*), which possess the ability to inflate their gullets until the body assumes



PUFFER FISH
From the South Seas

an almost spherical shape. See PORCUPINE FISH; SWELLFISH.

PUFFIN, the common name for one of a group (*Fraterculinae*) of web-footed maritime birds of the auk family (*Alcidae*) found in northern regions. Stocky in build, they range in length from 11 to 15 in., with plumage usually black above and white or grayish below. They are remarkable for their enormous bills, grooved, laterally compressed and brilliantly colored, portions of which are shed regularly. Puffins are birds of strong direct flight and gregarious habit,



PUFFIN

spending most of their lives in the open sea, where they feed upon fish eggs, crustaceans and various other forms of aquatic life. On certain rocky slopes and cliffs in the arctic they breed in vast numbers, nesting in a burrow or a deep crevice in the rocks and laying a single, sometimes spotted, white egg. The best known are the common puffin or sea parrot (*Fratercula arctica*), of the North Atlantic, wintering southward to Maine, the eggs and young of which were formerly prized for food, and the horned puffin (*F. corniculata*) and the tufted puffin (*Lunda cirrhata*), both of the North Pacific, the latter ranging southward to California.

PUGET SOUND, an arm of the sea penetrating the northwestern corner of Washington between the Olympic and Cascade mountains. It is formed from a partially drowned drainage system, the valleys of which are sufficiently sunken to unite, turning the intervening uplands into islands. Generally they have shores rising in sea cliffs from the water's edge, with similar steep slopes below the water leading down to maximum depths of 600 to 900 ft. There are two major canals, the Hood at the foot of the Olympic Mountains, and Admiralty Inlet which carries the bulk of the commerce of the sound. The harbor cities of Seattle, Tacoma, Everett and Bellingham are located on its margin and Juan de Fuca Strait provides a direct route to the Pacific Ocean.

PUGIN, the name of a family of English architects founded by Augustus Charles, born in Nor-

mandy in 1762, who moved to England and devoted himself to the study of Gothic buildings. He made the plans of many of them and published several books upon Gothic architecture in England and Normandy, and contributed greatly to the Gothic revival of the 19th century. His son, Augustus Welby Northmore (1812-52), was born in London, Mar. 1, 1812 and studied in his father's office. He became one of the leading architects of the Gothic revival but bitter disputes have raged over his work, notably as to his share in the design of the Houses of Parliament in which he assisted SIR CHARLES BARRY. Augustus died at Ramsgate Sept. 14, 1852. His son, Edward Welby (1834-75), was born in London Mar. 11, 1834 and continued the family tradition, building Gothic parish churches throughout the British Isles and colonies. Edward died at London, June 4, 1875.

PUJUNAN, a synonym for MAIDU, a North American Indian linguistic stock and tribe.

PULASKI, COUNT CASIMIR (1748-79), Polish patriot and American soldier, was born at Podolia, Poland, in 1748. During the uprising against Russia in 1768-72, called the Confederation of the Bar, Casimir and his father, Joseph Pulaski, led the Catholic rebels. Before the suppression of the insurrection Pulaski became commander-in-chief of the insurgents. Exiled in 1772, he went to America, where he joined the Continental army in 1777. Because of his bravery and skill at Brandywine, he was appointed a brigadier-general. With the consent of Congress he organized Pulaski's Legion in 1778, and with this independent body of cavalry and light infantry defended Charleston in 1779. He was mortally wounded in an attack at Savannah, and died on Oct. 11, 1779.

PULASKI, a town in southern Tennessee, the county seat of Giles Co. It is situated on Richland Creek, 78 mi. south of Nashville and is served by bus lines and the Louisville and Nashville Railroad. The region produces corn, cotton, fruit, melons, poultry and livestock. The town has lumber mills and a machine shop. Pulaski is the seat of Martin College for girls. The town was founded in 1807 and incorporated in 1819. The original Ku Klux Klan was founded here. Pop. 1920, 2,780; 1930, 3,367.

PULASKI, an industrial city in southwestern Virginia, the county seat of Pulaski Co., situated 60 mi. southwest of Roanoke, in a coal, lead and iron mining region. It is served by the Norfolk and Western Railroad. The rapidly growing city has blast furnaces, foundries, machine shops, and furniture, hosiery and chemical factories. Situated between the Blue Ridge and the Allegheny mountains, Pulaski is a popular summer resort. Pop. 1920, 5,282; 1930, 7,168.

PULCI, LUIGI (1431-87), Italian poet, was born at Florence, Dec. 3, 1431. Under the patronage of the de' Medici family, he produced his outstanding work, the *Morgante Maggiore*. This is an epic in 28 cantos narrating the adventures of a giant accompanying Orlando and converted to Christianity. This epic is the first genuine instance in modern literature of burlesque poetry and is celebrated for its droll satire.

Its characteristic irreverence and its undue prolixity have been no bars to a pervasive influence on European literature. Byron translated the first canto into English verse. Milton and Voltaire have expressed their admiration. Leigh Hunt called Pulci the first genuine romantic poet after Dante. Pulci died obscurely in 1487.

PULITZER, JOSEPH (1847-1911), American newspaper publisher was born in Budapest, Hungary, Apr. 10, 1847. He came to America during the last year of the Civil War, serving one year in the Union Army. He subsequently entered journalism in St. Louis, joining the staff of the *Westliche Post*, of which he ultimately became managing editor and part owner. He was admitted to the bar, elected to the state legislature and supported Horace Greeley in his campaign for the presidency. After working for a time as a special correspondent for the *New York Sun* under Charles A. Dana in Washington and in Europe he acquired the *St. Louis Post-Dispatch* and made it the city's leading evening paper. In 1883, he bought the *New York World* and in 1887 established the *Evening World*, both of which reflected his vigorous and independent editorial policies. He bequeathed Columbia University a fund to establish a school of journalism, and also established annual prizes in letters, drama, music and newspaper work. Died in Charleston, S.C., Oct. 29, 1911.

PULITZER PRIZES, annual awards for meritorious work in the fields of journalism and literature. A special fund was set aside for this purpose by Joseph Pulitzer in connection with his endowment of the School of Journalism at Columbia University. The prizes are given for: (1) The most disinterested and meritorious service rendered by an American newspaper, a \$500 gold medal. (2) The best example of a reporter's work, \$1,000. (3) The best example of newspaper correspondence, \$5,000. (4) The best editorial article, \$500. (5) The best American newspaper cartoon, \$500. (6) The American novel which shall best present the whole atmosphere of American life, \$1,000. (7) The best history of the United States, \$2,000. (8) The best American biography, \$1,000. (9) The original American play performed in New York City, which shall best represent the educational value and power of the stage, \$1,000. (10) The best book of verse by an American author, \$1,000. Juries for the prizes are chosen from the staff of the School of Journalism and from the National Institute of Arts and Letters. Winners of the award for the best American novel have been: Ernest Poole; Booth Tarkington; Edith Wharton; Willa Cather; Margaret Wilson; Edna Ferber; Sinclair Lewis; Louis Bromfield; Thornton Wilder; Julia Peterkins; Oliver La Farge; Margaret Ayer Barnes and Pearl S. Buck. Winners of the awards for American plays have been: Jesse Lynch Williams; Eugene O'Neill; Zona Gale; Owen Davis; Hatcher Hughes; Sidney Howard; George Kelly; Paul Green; Elmer L. Rice; Marc Connelly; Susan Glaspell; George S. Kaufman; Morris Ryskind and Ira Gershwin.

PULLEYS, driving or driven wheels with rims designed to carry belts of flat, round or V section, and are usually of cast-iron, steel, pressed paper or wood. They are now almost universally made in halves and clamped on the shaft at the location desired; formerly they were solid, which necessitated putting them on the shaft from one end. Steel pulleys are made of sheet steel, pressed into shape and the parts riveted or welded together. Those of wood are built of sections glued and bolted together. The rims, or faces, are finished to suit the type of belt to be used, straight across or slightly crowned for flat belts, and grooved to take either V or round belts.

PULLMAN, GEORGE MORTIMER (1831-97), American inventor, was born in Chautauqua county, N.Y., Mar. 3, 1831. He learned the trade of cabinet maker and in 1853 under contract he moved many buildings in order that the Erie Canal could be widened. He removed to Chicago in 1859 and that year he produced two sleeping cars remodeled from railroad coaches. After demonstrating their usefulness, in 1863 he built the first new sleeping car, *Pioneer*, according to the plan of the cars now used in the United States. The Pullman Palace Car Co., of which he was president the rest of his life, was soon organized and in 1880 the model town of Pullman, Ill., which was later annexed to Chicago, was established for the welfare of his employees. In 1887 he developed the idea of vestibule trains and introduced the dining car on the Union Pacific Railroad. He died in Chicago, Ill., Oct. 19, 1897.

PULLMAN, a city in Whitman Co., southeastern Washington, situated 79 mi. south of Spokane. It is served by bus lines and the Union Pacific and the Southern Pacific railroads. The city is a trade center in a wheat-growing region, and the seat of Washington State College, with an enrollment of 3,500 students. Pullman was founded in 1877 and incorporated in 1888. Pop. 1920, 2,440; 1930, 3,322.

PULMOTOR. See ARTIFICIAL RESPIRATION.

PULP, in mining, pulverized ore, gangue and rock when it is mixed with water, as is sometimes done in separating and concentrating it. Dry crushed ore is sometimes also called pulp. See also ORE TREATMENT.

PULP WOOD. There are four important processes for the making of PAPER from pulp wood; one is mechanical, and three are chemical, the latter being the sulphite, soda and sulphate processes. On an air-dry basis (10% moisture) the average yield of pulp per cord of wood is commonly assumed to be one ton in the mechanical process and one-half ton in the chemical processes, but there are wide variations. The chemical pulps are generally stronger than mechanical pulp because of the broken fibers which occur in the grinding stage of the latter process.

PULSE, the pressure of the heart beat felt in the arteries as blood is forced into them by the heart. The contraction of the heart forces a new quantity of blood into the aorta, the large artery leading from the heart. With the end of the heart beat, which occurs

in 0.3 of a second, the sharp recoil of the aorta drives the blood forward into the elastic arteries. These are first distended and then sink back to their normal size. The pulse, then, is felt as the alternate distention and contraction of the arteries, and passes through the arteries, from point to point, in the form of a wave. The velocity of the pulse wave has been stated to vary between 6 and 9 meters per second for adults.

By feeling the pulse, the physician is able to obtain information concerning the heart and circulation, whether the frequency is above or below normal, whether the rhythm is regular or irregular, whether the pulse is full or weak and if the wave rises and falls rapidly or slowly.

W. I. F.

PULSOMETER, a mechanism for elevating, or pumping, liquids by the pressure of steam or compressed air. It consists of two bottle-shaped chambers having a common neck, the inlets of the two chambers into that neck being such that they may be alternately opened and closed by a single steel ball which acts as a valve. Each chamber also has two check valves, one to admit water from a supply pipe and the other to let it escape under pressure to an outlet line. The common neck is connected to a steam, or compressed air, supply. In operation, steam enters the chamber that is not closed by the ball valve and forces the water out and condenses, creating a vacuum which draws the ball over the steam inlet and draws in water from the supply line. With the ball in this position, steam is directed into the other chamber, where the same action takes place as in the first chamber. This sequence is repeated automatically, so that water is pumped alternately from the two chambers.

PULVERIZED FUEL. Complete combustion of any solid fuel necessitates disintegration at high temperatures in order that each of its carbon atoms may find and mate with a corresponding atom of oxygen from the surrounding air. Failure in this results in incomplete combustion, hence, waste and inefficiency. One ideal way of accomplishing complete combustion is by gasifying the coal, but that involves too great an expense. However, complete combustion can be greatly facilitated by pulverizing the coal to an impalpable dust of about the fineness of talcum powder. As the saving resulting from the higher degree of combustion frequently more than offsets the cost of preparing, transporting and feeding it, about eight per cent of the bituminous coal (*see* FUELS) consumed in the U.S. is pulverized before burning.

The use of powdered coal has developed rapidly; cement manufacturers alone use some 8,000,000 tons annually. More than 25,000,000 tons are used annually in the generation of power and steam; some 3,000,000 tons in metallurgical furnaces; an equal amount in the smelting and refining of copper and other non-ferrous metals; and about 2,000,000 tons for miscellaneous purposes, such as firing marine boilers, locomotives, glass furnaces and ceramic kilns. The factors leading to the increased use of pul-

verized coal are: the ability of the installations to burn cheap low grade coals with maximum efficiency; flexibility in operation and control substantially equal to that obtained in burning the higher-priced oil or gas; and low labor costs. At present, pulverizing costs average from \$0.30 to \$0.60 per ton of coal, depending upon cost of power, wage rates, and technical results desired.

Most of the older and many of the larger modern pulverized fuel installations are of the so-called *storage* type, in which the coal is conveyed from the pulverizer to a storage bin adjacent to the point at which it is to be fired, and then transported from this bin to individual feeders and burners. This method has the advantage of more uniform and usually finer grinding, resulting from the continuity of grinding operations, as well as the advantage of a reserve fuel supply for unexpected load demands. Other advantages lie in the greater uniformity of pulverizer motive power requirements and the ability to grind the coal when power is not needed for other services. The disadvantages of the storage type installation are that it is somewhat complicated, involves a high initial cost and occupies considerable space. In the so-called *direct fired* or *unit* system, in which the grinder, conveyor and burner are in one self-contained unit, the coal is pulverized, fed and burned as needed. This system costs less, is simpler and requires less space. Its disadvantages include possible service interruptions, somewhat less flexibility in operation than the storage system, and the necessity of using maximum power for grinding when power is most needed from the plant. In the direct fired system the powder is blown by a fan direct from the pulverizer to the burner. In the storage system, screw conveyors were formerly used, but, in the modern plants, small amounts of air are introduced into the powdered coal to give it a fluidity which permits its being forced with screw-pumps as much as a mile.

Drying the raw coal before pulverizing is nearly always resorted to with the storage system and sometimes, with high-moisture coals, in the direct fired system. Moisture in coal has a direct effect on grinding and handling; the difficulty and cost of fine pulverization and transport increasing in general with an increase in moisture. Drying may be effected either in rotating cylinders by the application of hot gases, externally or internally, or by passing waste flue gases directly through the coal. Exhaust STEAM has also been employed for drying coal.

Pulverized coal burners are classified, according to the direction in which they project the coal into the furnace, as *horizontal* or *vertical*. In some burners, only a portion of the air necessary for combustion is admitted through the burner with the pulverized coal, while, in others, all of the air required is introduced with the coal. In the former type, that air not passing through the burners is admitted through secondary combustion air openings varying in location to suit the furnace design. Often, such "sec-

ondary" air is drawn through lateral ducts within the furnace walls, cooling them and, in turn, being heated to facilitate combustion. Burners may also be classified as of the *straight shot* type, in which the powdered coal and air mixture is projected directly along the axes of the conveyor pipe and burner orifice, and of the *mixing* type, in which intimate and thorough mixing of air and powdered coal is accomplished before delivery to the furnace. Mixing type burners give rapid ignition, hence, a short flame, and thus made possible the use of small and comparatively inexpensive furnaces.

Efficient burning of powdered coal usually requires somewhat larger furnaces than would be required by an equal amount of fuel fired by other methods. A safe average design allowance is one cubic foot of furnace volume to each one and one-half pounds of coal fired per hour.

H. W. B.

BIBLIOGRAPHY.—H. W. Brooks, *Powdered Coal in American Industry*, 1929.

PULVERIZERS, machines for breaking hard materials, as coal, into small particles. They may be divided into three general classes according to method of grinding and to speed of operation: slow, medium and high speed. Ball mills, or tube mills, are typical of the first class. They consist of a rotating horizontal cylinder partly filled with small steel balls. Grinding is done both by impact of balls on balls, or balls on liners, and by attrition between the balls as they slide over each other. These mills are especially suited to grinding abrasive materials and are frequently used for anthracite coal.

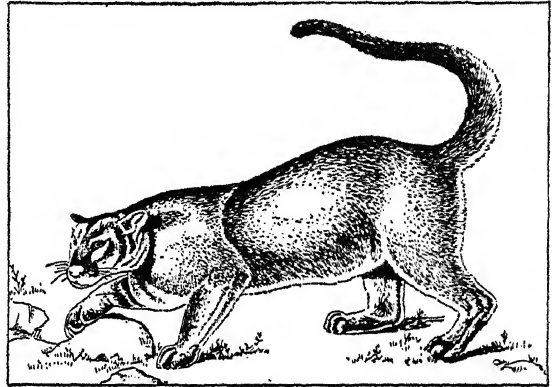
Roller mills and centrifugal ball mills are typical of the medium-speed class. The grinding is done mostly by the rolling of the rolls or balls on a "race." To get sufficient pressure between the grinding members for breaking down the material, either centrifugal force or spring pressure is employed. These mills, except with abrasive materials, have low maintenance costs and generally use less power than any other type.

High-speed mills are usually called *impact* mills, although considerable grinding is done by attrition produced by the high-speed grinding members as they are dragged through the material being pulverized. Mills of this type are usually compact and simple to operate but, except with soft materials, are wasteful of power when fine pulverizing is done. "Classifying" a material with the last two types of mills may be done internally or externally by means of air or screens. When hot air is used, drying may be accomplished at the same time as grinding, eliminating preliminary drying.

J. C.; K. T.

PUMA, a large exclusively American cat (*Felis concolor*), formerly distributed from southern Canada to Cape Horn, a range exceeded by no other American mammal. The puma approaches the jaguar in size, but is more slender and agile, readily climbing trees. Full-grown males measure about 6½ ft. in length to the root of the long tail and weigh about 150 lbs.; the females are smaller. It is characterized

by having an unspotted coat of short, soft hair, varying in color with individuals from fox-red to slaty blue, but white below, and without markings other than small touches of white and black on the face. The young, usually two to four at a birth, are at first temporarily spotted. The early explorers naturally mistook the plain, tawny skins shown them by the natives for those of a lioness, and "lion" (Spanish, *leon*) or more usually "mountain lion," is still the animal's popular name from Montana to Chile. The English settlers in New England spoke of it wrongly as a panther or "painter" (a leopard) or "catamount."



PUMA OR COUGAR

"Cougar," still heard in the South, is a meaningless word, so that the Peruvian native name, puma, has been widely adopted by naturalists, as the only properly distinctive name of this cat.

Although the puma was probably never numerous in the United States, and has become virtually extinct east of the Rocky Mountains, it was much feared by early settlers and frontiersmen, who claim to have heard its terrifying screams in the woods at night, yet very rarely has man or child been struck down by it. On the contrary, the puma is noted for dogging a man's trail, or lurking about a hunter's camp, or a frontiersman's shanty at night; and in many cases when suddenly met in the woods, has suddenly slunk away as if in cowardice, or when "treed" by dogs has given up abjectly. Extraordinary accounts of a playful friendliness in the pumas of the pampas of Argentina are given by reputable writers. The puma preys on all small animals, and kills deer and wild sheep whenever opportunity offers. Since the settlement of the western plains and valleys the puma in some localities has proved an unendurable pest, killing young horses, calves, sheep, and pigs. This has resulted in severe repressive measures; but in the mountainous wilds of the West and in the jungles of the tropics, the species should long survive. E. I.

PUMICE, a frothy glass produced in volcanic rocks by the sudden expansion and escape of included gases, when pressure is relieved by the rock being thrown, or poured out on the surface. The color is white, yellowish, gray, brownish, and rarely red. The structure is highly vesicular, like a sponge, so

pumice will float almost indefinitely, and pieces are washed ashore in all parts of the world. It does not form independent rock masses, but occurs as crusts on LAVA flows, and in individual pieces ejected from volcanoes. Chemically it compares with the GRANITES.

Especially noteworthy occurrences are in Yellowstone Park, Hungary, Iceland. The commercial production is derived from the Lipari Islands, off Sicily. Pumice is used as an abrasive and polishing agent. See also OBSIDIAN; PITCHSTONE; VULCANISM; PETROLOGY; SCORIA.

PUMMELO, a name given in various parts of the world to the citrus fruit (*Citrus maxima*) now commonly known as GRAPEFRUIT.

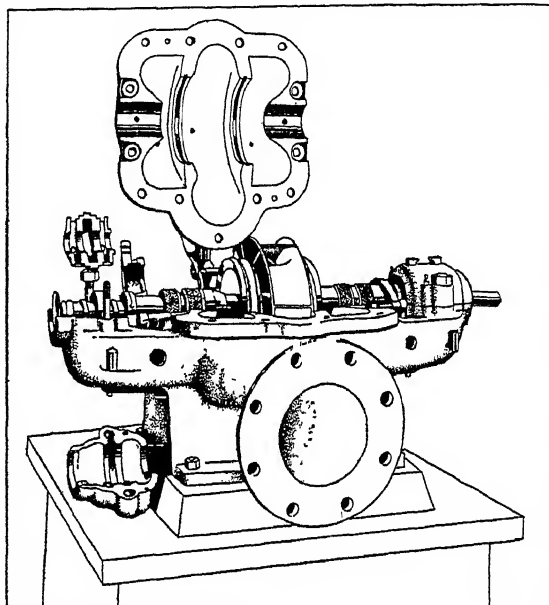
PUMPKIN, a name applied loosely to the large plants and fruits of certain annual vines of the gourd family. In Europe it designates those of *Cucurbita maxima*; in America, those of *C. Pepo* and *C. moschata*. But all these species are progenitors of varieties known both as pumpkins and squashes. To *C. maxima*, whose nativity is undetermined, belong the huge fruited varieties, such as mammoth Chili, often weighing 200 to 300 pounds; to *C. Pepo* of tropical America, the common yellow field and sugar pumpkins, pattypan, crookneck and scallop summer squashes and European vegetable marrows; to *C. moschata*, possibly East Asian, the winter crookneck, cushaw, Canada crookneck and China varieties. In America the mammoth squashes are used for exhibition and advertising and the field and sugar pumpkins, for pies. Both kinds are utilized for stock feeding. The early varieties mentioned are cooked as vegetables. See SQUASH. M. G. K.

PUMPKIN SEED, a name often applied, because of its shape, to the common SUNFISH, a small, freshwater food and game fish of the eastern United States.

PUMPS, machines used to lift fluids from one level to another, or to force fluids into a container or through a pipe line under pressure. The types most commonly used for WATER SUPPLY are: 1. Reciprocating, which may be either "single acting" or "Compound."

Water flowing into the chamber of these pumps as the plunger, or piston recedes, is forced to the outlet by the return movement of the plunger, forming an almost continuous discharge. For large units requiring from 700 to 1,500 horsepower and with daily capacities of from 15 to 40 million gallons, the vertical triple-expansion type is efficient and economical, but for smaller installations the "cross-compound" costs less and is but slightly inferior in "duty," or gallons pumped per pound of steam. Shock due to sudden acceleration of the column of water in reciprocating pumps is minimized by an air chamber on the delivery side, and sometimes on the suction side of the pump. The air in these chambers is compressed and expanded as the fluid surges into or out of the cylinder, thus equalizing the flow in the pipe lines.

2. Centrifugal pumps in which water enters the space between the "vaness," or PROPELLERS mounted on a rapidly revolving shaft at the axis of the pump. The casing of the pump may be either split or of integral construction. For the higher pressures they are built with more than one pump element, or "stage," the discharge pressure being the summation of that developed by the several stages. Centrifugal pumps may operate



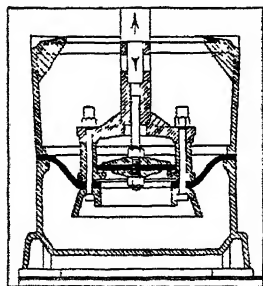
COURTESY ALLIS CHALMERS MFG CO

CENTRIFUGAL TYPE PUMP WITH HINGED COVER RAISED

at pressures as high as 2,000 pounds per square inch, the discharge being continuous and without shock.

Rotary displacement pumps are adapted for use with a comparatively low head, as in pumping for IRRIGATION, and have the advantage of a practically continuous discharge. They comprise either a drum mounted eccentrically in its casing and carrying sliding diaphragms that make contact with the casing; or two rotating elements, shaped somewhat like gears, mounted on parallel shafts.

Screw pumps comprising an impeller element resembling the SCREW OF ARCHIMEDES turning in a casing, have long been used and have undergone recent improvement. Another type of pump, the PULSOMETER, is described elsewhere. The air lift pump consists of a vertical "eduction" pipe with its lower end submerged in a well; air under pressure being delivered by a small pipe to the bottom of the eduction pipe. The rising column of water in the eduction pipe is, therefore, a mixture of air and water which, being lighter than water by itself, is lifted by the pressure of the surrounding water in the well. Other pumps, not in common use, are the Humphrey Gas



COURTESY NOVO ENGINE CO

SECTIONAL VIEW OF ONE TYPE OF RECIPROCATING PUMP
Heavy line is a flexible rubber diaphragm

Pump and the HYDRAULIC RAM. *See also* INJECTORS; DEEP-WELL PUMPS. E. E. W.

PUNCH or *The London Charivari*, a British illustrated weekly noted for its brilliant wit and satire. Named for the puppet-show "Punch," and modeled somewhat on the French *Charivari*, it was conceived probably by Henry Mayhew and Ebenezer Landells, and was first issued July 17, 1841 under the editorship of Mark Lemon. Staunchly representing the British point of view, always throwing its weight against political abuses (*Punch* helped to abolish capital punishment for minor offences), it has numbered among its contributors the greatest wits and artists, including Thackeray, Hood, Artemus Ward, Douglas Jerrold, Caron d'Ache, George Du Maurier and Sir Owen Seaman.

PUNCH AND JUDY, two puppet characters, the first, originating in Italy, it is said, about the beginning of the 17th century. The English Mr. Punch was derived in 1688 from the Italian puppet figure Punchinello, known as Polichinelle and later Guignol in France. It is thought that Punchinello got his name from the Italian word *pulcino*, meaning chicken, or the figure of the Roman clown Maccus, whom he resembled with his ugly humpback, hooked nose and prominent features. Punchinello was successfully introduced in Paris during the reign of Louis XIV, at a fair. He soon was a favorite with the nobility and intellectuals and became a character in plays dealing exclusively with French heroes and legends.

When all the regular theaters were closed in England in 1642, MARIONETTE shows were the only public dramatic performances given. The puppeteers freely used the plots of great plays and operas. After Punchinello became Mr. Punch, married Judy and their domestic quarreling began, he became the bragging, cowardly, brutal character, familiar at the present time. The main plot and minor characters of Tobey, the dog, and Punch's son have also remained practically the same.

PUNCHES, tools for cutting or driving holes in thin materials. They vary from the simple hollow tube with a cutting edge, used to cut holes in paper, cloth or leather, to intricate solid punches for punching holes of various sizes and shapes in metal sheets. The hollow punches cut through the soft material, forcing the "cuttings" up through the hole in the center. In punching the harder materials with solid punches the work is supported on a metal die having a hole the same shape as the punch but a trifle larger, to allow the punch to pass into the opening, forcing the cuttings ahead of it. Punches may be operated by a system of levers or by blows from a hammer. In power work they are attached to a power press.

PUNCHING AND SHEARING MACHINES are used in fabricating structural steel work where it is necessary to both punch and shear the pieces to be riveted together. This led to machines being built that will perform both operations, usually on opposite sides of the machine. The two operations can be performed separately or both punch and shear

can be operated at the same time, but not on the same piece of work. Punching machines for large special work are made to punch a large number of holes at the same time and in any pattern desired. In some machines the action of the punches is controlled by a perforated strip of paper that admits air to actuate certain punches, much as in a player-piano.

PUNCTUATION, the theory or art of inserting points or stops, the various marks of punctuation, in written or printed matter to make it easier to read and incapable of misinterpretation. In general, marks of punctuation do for writing what pauses and inflections of the voice do for speech, setting off or indicating the relationship between various words, phrases, clauses, sentences, etc. It is impossible, however, to lay down any absolute and finally binding set of rules for the use of the various marks, for usage varies considerably both from time to time, and from individual to individual. At best, rules merely indicate general practices to which there are many exceptions.

In general, a period denotes a full stop, and is used at the end of a sentence which merely states a fact. If the sentence asks a question, a question mark is used instead; and if it indicates surprise, indignation, or some other violent emotion, an exclamation point is employed. A period is also used to indicate an ABBREVIATION.

The semicolon marks a less important break in the thought than the period; it separates clauses, or sometimes phrases, more or less equal in value which must be taken together to form a unit of thought.

The colon indicates that something is to follow—a formal explanation, an illustration, or a proof of the statement that has just been made, or an enumeration. It is also used to introduce a fairly long direct quotation, the comma generally introducing a short one.

The dash denotes an unexpected interruption of the thought or a sudden change of thought; parenthetical matter, if sufficiently important, is occasionally set off from the rest of the sentence by dashes instead of by parentheses.

Parentheses enclose explanatory material inserted in a sentence or paragraph if the inserted matter interrupts the general progress of the thought. Brackets are used to enclose editorial comments or information, i.e., something inserted by other than the original writer of the passage.

The comma is the most troublesome of all marks of punctuation. It indicates only a very slight break or pause in the thought, but there is wide variation and inconsistency in its employment, and authorities flatly disagree upon some of its usages. These are too numerous to mention, but the present tendency seems to incline to the use of fewer and fewer commas. K. D. S.

BIBLIOGRAPHY.—T. F. and M. F. A. Husband, *Punctuation: Its Principles and Practice*, 1905; G. Summey, *Modern Punctuation*, 1919.

PUNCTURE WEED (*Tribulus terrestris*), a white-hairy annual herb of the caltrop family, native to Europe and introduced in various parts of the United States, sometimes becoming a pest in alfalfa fields. The usually decumbent stems, widely branched from the base, bear pinnate leaves, small yellow flowers, and bony nutlets armed with long stout spines.

PUNIC WARS, three wars, between Carthage and Rome, extending from 264-146 B.C., with 45 years of actual fighting. By 264 B.C. Rome was the leading Italian power, and, as such, a serious menace to Carthaginian trade. A mere pretext precipitated an exhaustive strife of 24 years, with Sicily as the battlefield. Each side had allies, a strong army, good generals and wealth. Rome surprised Carthage by developing a navy, which materially aided her success. The treaty of 241 B.C. provided for a money indemnity and the cession of Sicily, to which were later added Sardinia and Corsica, to Rome.

By 218 B.C., HANNIBAL, son of a hero of the first war, felt that Carthage was sufficiently entrenched in Spain to risk a renewal of hostilities. He led an army overland, by the Alps, into Italy, and harassed the country almost to the walls of Rome. The Battle of Cannae, 216 B.C., was the crisis. Rome suffered the most overwhelming defeat of her existence; but her stamina and the fidelity of her allies, combined with cautious strategy, called Fabian, after her general Fabius, extended the war until Carthage, her forces dissipated, sued for peace in 201 B.C. She was left a minor Power, while Rome, already the leader in the Hellenistic world, took from her the province of Spain. Rome never forgave her enemy; the faction of wealthy landowners led by MARCUS CATO, the elder, jealous of the economic strength she retained and determined to convert Libya into a granary for Rome, insisted: "Carthage must be destroyed." A third war was provoked in 149 B.C., ending in the complete destruction of the city. A plow was run over its site in 146 B.C., and a new province, Africa, added to the Roman dominions.

PUNISHMENT, in the form of revenge or retribution, is the oldest mode of securing interests or authenticating rights. It is now appropriated almost exclusively to the criminal law, but there are still remnants in legal systems of an older condition in which punishment was referred to for the enforcement of private rights. Examples are, double or even quadruple damages in certain cases, as, for instance, of injuries by dogs, civil damages in certain cases, such as failure to release a chattel mortgage of record, and punitive damages. In the past, punishment has been the sole resource of the criminal law. The tendency to-day, however, is to think of penal treatment rather than of punishment, and to seek to make penal treatment fit the criminal rather than to make punishment fit the crime. Of the theories of punishment which are current, the most important are the retributive theory which thinks of a penalty as required by justice to restore the balance of right

and wrong when wrong has been committed, and consequently of an exact, just penalty corresponding to every offense; the social utilitarian which seeks to adjust penal treatment to the offender so as to make him, so far as possible, a useful member of society, and the deterrent theory which conceives of punishment as maintaining the general security, in that the threat thereof deters those who otherwise would offend.

PUNJAB, a province of northern India, composed of territories belonging to Great Britain and of 34 Indian states. The total area is 133,741 sq. mi., of which 37,059 belongs to the states and the rest to the British Crown. The province is crossed by five important rivers, from which it derives its name "five rivers," the Sutlej, Jhelum, Chenab, Beas and Ravi, all affluents of the Indus. Wheat is the principal wealth and the main export. Other products include barley, tobacco, rice, maize, cotton, sugarcane and fruits and vegetables. Tea and indigo are also produced and exported. After agriculture, weaving on the hand-loom is the most important industry, in which at least 200,000 people are engaged. The capital of the province is Lahor, with a population of 282,000. From May to October the Government Offices are removed to Simla, where the Governor maintains a summer residence. Other important cities are Amritsar and Rawalpindi. Of the total inhabitants a little more than half are Mohammedans and the rest Hindus and Sikhs. Pop. 1921, 20,685,024; 1931, 23,580,520.

PUNKIE (*Culicoides*), a blood-sucking midge of the dipterous family *Chironomidae*. It is about one-tenth the length of a mosquito and flies chiefly early in the morning and at dusk, inflicting very severe, burning bites. The eggs are laid usually in fresh water pools. The larvæ are very slender, with small brown heads and tufts of hair on the posterior end.

PUNTA ARENAS, see MAGALLANES.

PUNTLATSH, a tribe of the North American Indian Salishan linguistic stock, the few remaining members of which appear to be with the Comox. They lived originally along Baynes Sound and Puntlatsh River in the eastern part of Vancouver Island. Puntlatsh formed a distinct dialect of Salishan, comprising Puntlatsh, Saamen and Hwahwatl.

PUNXSUTAWNEY, a borough in Jefferson Co., western Pennsylvania, situated 45 mi. northwest of Altoona. It is served by two railroads. Punxsutawney is a shipping market and trading center for a region devoted to farming, dairying, stock-raising, also to coal-mining and coke-making interests. The borough has packing plants, boiler works, railroad and machine shops, and glass, polish and silk factories. Punxsutawney was founded in 1812; incorporated in 1845. Pop. 1920, 10,311; 1930, 9,266.

PUPA. In those insects which have complete metamorphosis, the form following the larva is designated the pupa stage. This is a period of internal transformation. Most pupæ are outwardly quiescent during this period. They move very little, and do

not feed at all. Many pupæ are enclosed in a protective case known as the cocoon. Some insects, notably butterflies, form naked pupæ called chrysalids. Pupæ of mosquitoes and some midges are active. Since the larval stage differs so markedly from the adult, it is in this intermediate pupal stage that the necessary bodily changes are effected.

PUPIN, MICHAEL IDVORSKY (1858-), American inventor, was born at Idvar, Hungary, Oct. 4, 1858. He went to the United States in 1874 and after some financial difficulties was graduated from Columbia University in 1883. He took advanced studies at Cambridge and Berlin, and from 1890 to 1901 taught at Columbia University when he became director of the Phoenix Research laboratories. He made a number of inventions improving long distance telephony, introduced the use of the fluorescent screen in X-ray work and discovered secondary X-ray radiation.

PUPPET SHOW. See MARIONETTES; PUNCH AND JUDY.

PUPPIS (gen. *Puppis*), the poop or stern, formerly a part of Argo the ship, now an independent constellation directly east of Sirius and Canis Major. It is rich in bright stars, double and variable stars. Among these is the fourth magnitude star V Puppis, an ECLIPSING BINARY composed of two stars, each about 20 times as heavy as the sun, revolving around each other in 1.5 days at a distance of only 5 million miles. See STAR: map.

PUP TENT. See TENT.

PURCELL, HENRY (1658-95), English music composer, was born at London in 1658 (the month and day are unknown). As a youth he sang in the Royal Chapel, studying the organ under John Blow, whom he succeeded as organist of the Royal Chapel and in 1683 as composer to the king. An able contrapuntist, an excellent melodist, and a tonal dramatist without a rival in his period, he may justly be described as the English HANDEL, his junior by 27 years, who profited considerably by a study of Purcell's sacred music, especially in the massed treatment of voices. His collected works fill 20 volumes, comprising more than a score of odes, a dozen "chamber-music sonatas," the opera *Dido and Aeneas*, incidental music to numerous plays, and about 200 songs, duets, and catches. Of his anthems, *My Heart is Inditing*, composed for the coronation of James II, and *Thou Knowest, Lord, the Secrets of Our Hearts*, written for the funeral of Queen Mary, require special mention. He is generally recognized as the foremost composer produced by England, and his epitaph in Westminster Abbey, observing that he has "gone to that blessed place where only his harmony can be exceeded," indicates the flattering opinion of his contemporaries. He died at London, Nov. 21, 1695.

PURCHAS, SAMUEL (c. 1575-1626), English man of letters, was born in Thaxted, Essex, about 1575, and educated at Cambridge and Oxford. He spent many years in the service of the church, and at the same time prepared compilations of reports on

voyages of travel and discovery. The most important of these is entitled *Hakluytus Posthumus, or Purchas His Pilgrimes, Containing a History of the World in Sea Voyages and Land Travells by Englishmen and Others*. Purchas died Sept. or Oct. 1626.

PURCHASING POWER. See REAL WAGES.

PURCHASING POWER PARITY. The rates of exchange between GOLD STANDARD countries remain normally between the gold points which lie on either side of and close to the mint or gold par. The quantity of fine gold constituting the British monetary unit is the amount contained in 4.8665 gold dollars (U.S.). When the United States exchange rate on England is at this figure it is said to be at par or parity. Between inconvertible or fiat paper using countries the exchange rates move without reference to such a par as this. The doctrine of purchasing power parity is in general terms the theory that if the ratio between the home purchasing powers over goods of the two fiat currencies could be ascertained, it would prove to be the center of fluctuation of the exchange rates between them. If one dolivar can buy as much goods in its country as 10 solivars can in their country the exchange rate ought to fluctuate about the central ratio of 10 to 1. The theory is the only tenable one, but as it is expressed it gives a false impression of exactitude. See also FOREIGN EXCHANGE.

A. C. W.

PURDUE UNIVERSITY, at Lafayette, Ind., a publicly controlled technological institution for men and women, founded in 1869 under the provisions of the Federal Land Grant Act. It was named for its chief benefactor, John Purdue, who, with other residents of Tippecanoe County, Ind., donated money and land for its foundation. The university comprises schools of Agriculture, Applied Science, Engineering, Home Economics and Pharmacy. It maintains agricultural and engineering experiment stations. In cooperation with the American Railway Association, the university has made an extensive investigation of power brakes and power-brake appliances. The university's productive funds in 1931 totaled \$2,553,695. The library of 101,537 volumes contains the Charles Major Library of History and Literature and the David L. Barnes Library of Railroad Engineering. In 1931-32 there was a student enrollment of 4,751 and a faculty of 455 headed by Pres. EDWARD C. ELLIOTT.

PURE FOOD LAW, the act creating the Food and Drug Administration of the United States Department of Agriculture. The basal Pure Food Law, enacted by Congress on June 30, 1906, is "an Act for preventing the manufacture, sale or transportation of adulterated or misbranded or poisonous or deleterious foods, drugs, medicines and liquors, and for regulating traffic therein, and for other purposes."

The administration of this law is under the control of the Secretary of Agriculture and the machinery necessary to enforcement has led to a subdivision of activities under various chiefs and assistant chiefs with specifically defined duties. Subsequent to the

passage of this act and the organization of the Federal administration thereof, all of the separate states of the United States have enacted state laws governing the manufacture and sale of products within their own boundaries. Many of these laws merely duplicate the Federal law provisions and safeguards. In many instances, however, they set up standards quite different from those of the Federal laws. For example, the amount of butter fat which must be in ice cream varies from 8 to 14%, according to the state wherein the product is sold.

The ordinary citizen's interest in these laws arises when he is either about to manufacture and sell a product or has bought a product about whose quality he is doubtful. For ease of contact with the persons capable and authorized to advise, the Government has established branches of the Food, Drug and Insecticide administration in various sections of the country. These sectional offices and the office of the Chief of the Food and Drug Administration at Washington, D.C., can supply information regarding this Act.

Dr. Harvey Wiley is often called the Father of the Pure Food Law. It was due largely to his efforts while chief of the U.S. Bureau of Chemistry that the Act was passed and manufacturers thereby forced to follow definite standards for products or become subject to seizure of their goods, trial and punishment if found guilty. Today the United States has a most effective policing of food, drug and insecticide products and a machinery which permits any citizen to secure full protection against adulteration and fraud. *See also* FOOD ADULTERATION. W. H. E.

BIBLIOGRAPHY—U.S. Circular No. 136, *Standards of Purity for Food Products*; C. W. Dunn, *Food and Drug Laws*, 1928.

PURGATIVES. *See* CATHARTICS.

PURGATORY, a theological term signifying an intermediate state after death in which, according to Catholic belief, the soul is prepared by expiatory discipline for admission to paradise. In *The Divine Comedy*, Dante describes a future existence as one comprehensive landscape, consisting of hell or the *Inferno*, purgatory and paradise. The prayers of the faithful on earth and Masses here celebrated assist the progress of the soul through the pains of purgatory. Moreover, the pope exercises an authority by the grant of INDULGENCES applicable to the souls in purgatory.

PURIM, a minor but popular Jewish festival which falls on the 14th day of the 12th Hebrew month of Adar, corresponding roughly to February-March of the common calendar. It commemorates the deliverance of the Jewish people of the Persian empire from the plot which Haman, a descendant of the Biblical Amalekites who were the traditional enemies of the ancient Hebrews, had made for their destruction. The events leading up to the celebration of the festival of Purim are described in detail in the Biblical Book of Esther. Here the story is told how Mordecai, the Jew, with the help of his cousin and foster-daughter Esther, who later became queen of Persia,

frustrated the fell scheme of Haman the Agagite, prime-minister of the Persian King Ahasuerus (Artaxerxes). The festival is called Purim (Persian, "lots") because Haman determined by means of casting lots to set the annihilation of all the Jews of Persia on the 14th of Adar. In Jewish leap-years, which occur every three years, Purim is observed on the 14th day of the Second Adar (Adar Sheni).

PURITAN REVOLUTION. *See* GREAT REBELLION.

PURITANS, THE, members or followers of a religious and political party in England in the 16th and 17th centuries, who endeavored to establish in a national Church a form of worship modeled on the Calvinistic Church at Geneva, and a conduct of life based on sincere and strict regard for the commandments of God as found in the Bible. Negatively, they are in part explained by Thomas Fuller (1608-61), who wrote, "The odious term of 'Puritan' was first applied in 1564 to those who resisted the attempt of the bishops in that year to enforce uniformity in ritual and in the use of vestments." The first great religious leader of the Puritans may be said to have been Thomas Cartwright (1535-1603), and the last, Richard Baxter (1615-91). While the Puritan movement began as a protest as above indicated, its opposition to unreal distinctions between the clergy and the laity and all that savored of Roman Catholicism, led it later to form "Separatist" churches. Under Queen Elizabeth much persecution was endured, but the Puritans gained in numbers under James I, and later, under Charles I, formed a strong support to his Parliamentary adversaries during the Civil War.

Prosecution and deprivation under the Acts of Uniformity, especially at the hands of Archbishop Laud, and the desire for freedom to worship as they wished drove large numbers across the Atlantic to New England. The Puritan colony at Salem was established in 1628, John Winthrop coming in 1630, John Eliot in 1631, John Cotton in 1633 and Richard Mather in 1635. From 1631 to 1664 voting in Massachusetts was restricted to church members. Standing first for an ecclesiastical ideal, the Puritans developed an intense preoccupation with moral issues, a depreciation of certain forms of art, a belief in original sin which led to unsympathetic judgments and a devotion to the God of Righteousness which almost obliterated the idea of the God of Love. On the other hand their stress on self-discipline, the performance of duty, the supremacy of conscience and the freedom of religion from the State, promoted constitutional liberty and laid the foundation of much of America's later industrial progress. The later history of the Puritans can be read in the histories of the churches called Congregational, Baptist and Presbyterian. (*See* articles under these heads.)

PURPLE-TOP (*Triodia flava*), an elegant perennial grass called also tall red-top. It is found in meadows and open woodlands widely throughout the eastern United States. The erect stem, 2 to 5 ft. high, often viscid above, bears long narrow flat leaves

and a large open panicle of drooping purple spikelets.

PURPURA, the term applied to an effusion of blood into the skin and mucous membranes. It may be apparent as purple patches, if recent, varying in size from pin-point to extensive areas over the body surface. When the mucous membranes are involved, actual bleeding may occur instead of purpuric spots.

Purpura is a symptom of divers causation, which may be common to many diseases. It may be insignificant, or it may cause a profound anemia from continued loss of blood. The original disease to which the term was first applied is purpura hemorrhagica described by Werlhof in 1731. Since this time, however, purpura has been associated with many other conditions such as infectious diseases, snake bites, blood poisoning, and intoxications. The various types of purpura may vary in degree, extent, localization and intensity.

The cause of this form of hemorrhage is, in many cases, still in doubt. Various organs and tissues have been held responsible. *Increased capillary permeability* is one of the most common explanations. It is an established fact that blood cells are able, under certain conditions, to pass through the thin capillary wall; if the permeability reaches a certain stage, blood cells may be allowed to escape in such a degree as to result in purpuric spots in the skin or mucous membranes. The size of the extravasation would depend upon the extent of this change. In diseases in which the vessel wall is primarily affected, as scarlet fever and scurvy, purpura is a frequent symptom. Snake venom has a definite damaging effect on blood vessels and the presence of purpura in cases of snake bite is common.

The *blood platelets* have also held an important place in explaining some types of purpura. They are small cells about one-third the diameter of the red blood corpuscle. On rupturing, the platelets liberate a substance necessary for clot formation. The present view is that the platelets exert a protective influence on the injured capillary wall. The property of platelets to adhere to an injured part of a vessel and cause a local clot, tends to serve as protection where the wall is weakened. Where platelets are reduced in number, their protective influence cannot be supplied and purpura results.

This is particularly well illustrated in the disease known as purpura hemorrhagica (Werlhof's Disease) which is coincident with a marked diminution in the number of blood platelets. In this condition spontaneous hemorrhage may occur in the skin, mucous membranes of the nose, stomach and intestine. Bleeding is periodical and there may be irregular intervals during which health is perfect and there is no tendency to bleed. After severe attacks weakness and anemia may result. Blood transfusion is beneficial in treatment of the anemia and causes a temporary increase in blood platelets. Some cases respond by an operation in which the spleen is removed (splenectomy) (see also *Spleen*).

In general, where purpura is a symptom of some other disease the treatment is directed to the underlying cause of increased capillary permeability.

H. G. P.

PURPURA HEMORRHAGIC. See. HEMOPHILIA; PURPURA.

PURSLANE (*Portulaca oleracea*), a fleshy prostrate annual of the purslane family called also pusley. It is widely distributed in many warm regions but is regarded as an introduced plant in the northern and eastern parts of the United States, where it is abundant



COMMON PURSLANE

as a weed. The freely branching stems bear small, oblong, very thick leaves and inconspicuous yellow flowers opening only in bright sunshine. The kitchen garden purslane (var. *sativa*), an erect plant, a foot or more high, grown as a potherb, is regarded as a cultigen.

PURSUIT PLANES. See AIR FORCE.

PUSAN, or **FUSAN-FU**, an important port situated on the southeasternmost extremity of the Korean Peninsula, acting as junction between the islands of Japan and the Korean mainland of the Japanese Empire. It is the terminus for a link of the Trans-Siberian Railway. The port was formally opened to trade in 1876. It has a porcelain factory but acts chiefly as an export base for Korean minerals and the reception of foreign imports. Pop. 1925, 116,207.

PUSHBALL, a competitive sport played on a field between two teams of 11 players each, with a ball 6 feet in diameter, weighing not less than 48 pounds. The field is commonly 140 yards long and 50 yards wide, with two goals, each consisting of two uprights 18 feet high, connected by a 20-foot crossbar placed at a height of 7 feet. Each team of the players consists of five forwards, two left wings, two right wings, and two goal keepers. Pushing the ball beneath the opponent's goal counts five; pushing the ball

over the goal horizontal, eight. Push ball was originated in 1894 by M. G. Crane of Newton, Mass.

PUSHKIN, ALEXANDER (1799-1837), Russian poet and dramatist, was born at Moscow, June 6, 1799, of a noble family. Adolescent influences included a miscellany of French literature, Byronism and a period of gypsy life in South Russia. The poet returned to Moscow in 1826 under the patronage of Nicholas I, and thereafter produced his most important work. *Lyric Poems*, published 1820-37, are simple yet brilliant outpourings of which Gogol has said "every word is boundless as is the poet himself." *Eugeny Onegin*, 1825-32, is a poetical love story involving the tragic spiritual life of the intellectuals of Russia. *Poltavia*, 1829, is an epic poem of Peter the Great, and is famous for its Ukrainian pictures. *Boris Godunov*, 1830, is a poetical drama similar in theme to Shakespeare's *Macbeth*. *The Copper Rider*, 1837, is a series of poetical effusions in connection with Peter the Great and his times, in which the copper statue becomes a symbol of Russia's future. Pushkin also wrote a number of minor works. His letters are said to be without rivals in Russian literature. He may be said to have been the first poetical incarnation of Russia's soul, and literally created its poetical language. His poetry expressed every mood of life and was characterized by a certain simplicity and charm as well as a universal quality of thought that has endeared it to educated Russians. Pushkin died Feb. 10, 1837, as the result of a duel.

BIBLIOGRAPHY.—Prince D. S. Mirsky, *Pushkin*, 1926.

PUSH-PULL AMPLIFIER, a type of radio receiver amplifier which consists of an input TRANSFORMER with a center tap on its secondary connected to the filaments of two electronic tubes (see TUBES, ELECTRONIC), one end of the secondary winding being connected to the grid of one tube, and the other end to the grid of the second tube. When there is ALTERNATING CURRENT in the system, the grid of one tube will increase in potential, while the other decreases. The fluctuations in the plate circuits of the tubes will be completely out of PHASE, but they may be combined by connecting the plates to the terminals of the primary of an output transformer, a center tap of which is connected to the "B" supply. (See RADIO RECEIVER.)

The chief advantage of the system is that all distortion caused by the formation of second harmonics in the tubes is balanced out so that greater FIDELITY for a specified amount of power is obtained. L. G. H.

PUSSY WILLOW, a name popularly given to any species of willow with soft furry aments (catkins) which appear before the leaves in early spring. The common pussy willow (*Salix discolor*) of eastern North America, with conspicuous silvery-silky aments about an inch long and half as thick, grows in moist meadows and on the banks of streams and lakes from Nova Scotia to Manitoba and southward to Delaware and Missouri.

PUT AND CALL. A put is a negotiable contract giving the holder the privilege to deliver or sell to

the maker a certain number of shares of a specified Stock at a fixed price within a certain specified time limit. A call is exactly the opposite, giving the holder the right to purchase from the person signing it a specified stock within a certain period at a specified price. The New York Stock Exchange forbids trading in puts and calls on its floor.

PUTEOLI, a maritime city of Campania in Italy, the modern Pozzuoli. Originally the Greek city of Dicaearchia, the Romans gave it its name either from the stench of its waters or because of the numerous wells located nearby. Six miles west of Naples on the gulf, it became the center of the trade with Alexandria and the northern part of Africa. In 215 B.C. Puteoli was fortified by the Romans and in 194 was colonized by them. Although 150 mi. from Rome, it nevertheless became the imperial port during the days of the Empire. Three times the city has been razed: first by Alaric in 410, then by Genseric in 455 and finally by Totila in 545. The remains of its famous pier still stand, this being built from a kind of cement for which the present city is still noted.

PUTNAM, AMELIA EARHART. See EARHART, AMELIA.

PUTNAM, FREDERICK WARD (1839-1915), American anthropologist, was born at Salem, Mass., Apr. 16, 1839. At 17 he was made curator of ornithology at Essex Institute in Salem, subsequently becoming superintendent of its museum, in 1866, and vice-president in 1871. He graduated in 1862 at Harvard, where he was curator of the Peabody Museum during 1873-1909, and Peabody Professor of Archaeology and Ethnology during 1874-1909. From 1903 to 1909 he also held the professorship of anthropology at the University of California, and was curator of its Anthropological Museum. In 1894-1903 he was curator of anthropology in the American Museum of Natural History, New York City. He was a founder of the American Anthropological Association and its president in 1905. In 1898 he served as president of the American Association for the Advancement of Science. Putnam was an industrious field-worker, participating in many archaeological and ethnological explorations throughout America during his active life. His chief contributions to science rest perhaps in his achievements in developing museum work and in stimulating the study of anthropology in the United States. He was the author of more than 400 publications covering a wide range of subjects. He died at Cambridge, Mass., Aug. 14, 1915.

PUTNAM, GEORGE HAVEN (1844-1930), American publisher, was born in London, Eng., Apr. 2, 1844, and educated at the Sorbonne and the University of Göttingen. During the Civil War he enlisted as private in the Union army and was advanced to the rank of major. Subsequently he entered his father's publishing house, G. P. Putnam's Sons, of which he later became president. He was a leader in organizing in 1887 the American Copyright League and instrumental in obtaining the passage of the

copyright bill in 1891. He founded the English Speaking Union in the U.S. His writings include *Books and Their Makers in the Middle Ages*, and *Memoires of a Publisher*. He died in New York City, Feb. 27, 1930.

PUTNAM, HERBERT (1861-), American librarian, was born in New York City, Sept. 20, 1861, and graduated at Harvard College in 1883. He studied law at Columbia University, and was admitted to the bar in 1886 in Minnesota. From 1884-87 he was librarian of the Minneapolis Public Library. He served as librarian of the Boston Public Library from 1885-99, and was then put in charge of the Library of Congress, Washington, D.C. In 1898 and again in 1904 he was elected president of the American Library Association. During the World War Putnam was engaged in Library War Service.

PUTNAM, ISRAEL (1718-90), American soldier, was born in Danvers, Mass., Jan. 7, 1718, and in 1740 took up farming in Connecticut. He volunteered for service in the French and Indian War in which he was promoted to major; and during Pontiac's conspiracy led the Connecticut troops in 1764 to the relief of Detroit. Prior to the Revolutionary War he vigorously opposed the Stamp Act and was a leading member of the Sons of Liberty. In April 1775, upon hearing of the fighting at Lexington, he left his plow standing in the field and rode to join the colonial forces. In response to his advice Breed's Hill was fortified and he was one of the commanders in that battle. After General Washington commissioned him a major-general in July, 1775, he served in the environs of New York and was highly esteemed for the faithful and dependable performance of his duty. He returned to his home in the winter of 1779. On starting for the winter quarters of the army, he suffered an attack of paralysis. This forced him to retire to his farm near Brooklyn, Conn., where he died on May 29, 1790.

PUTNAM, RUFUS (1738-1824), American soldier and pioneer, was born in Sutton, Mass., Apr. 9, 1738. In his early years, he was by trade a millwright. He served in the French and Indian War from 1757-60 and was mustered out with the rank of ensign. He resumed his trade, studied mathematics and engineering and for a brief period acted as a surveyor in Florida. During the Revolutionary War Putnam supervised the construction of several important fortifications for the patriot army, ultimately attaining the rank of brigadier-general in 1783.

After the war Putnam was a member of the Massachusetts legislature and in 1786 he was the chief promotor of the Ohio Company which in 1787 purchased an enormous tract of land in the Northwest Territory from the national Government. Putnam led the first party of settlers to the region and in 1788 founded the town of Marietta in what later became the state of Ohio. He was appointed one of the three Federal judges of the Northwest Territory, 1789, and from 1796-1803 he was the surveyor-general of the United States in the territory. His energy, cour-

age and judgment were important factors in the development of the early northwest. He died in Marietta, May 4, 1824.

PUTNAM, a city in northeastern Connecticut, the county seat of Windham Co., situated on the Quinebaug River. The New Haven Railroad and bus lines serve the city. It is situated in a good farming region, and is an industrial center producing textiles and phonograph needles. The town was established in 1855 and the city incorporated in 1895. Putnam was named for Gen. ISRAEL PUTNAM. Pop. 1920, 7,711; 1930, 7,318.

PUTTENHAM, GEORGE (c. 1530-90), English writer, was probably born about 1530. His fame rests upon the fact that a book called *The Arte of English Poesie* is attributed either to him or to his brother. The author says he was educated at Oxford and traveled in Europe. *The Arte of English Poesie* was written for Queen Elizabeth and her ladies, and was published in 1589. Puttenham died about 1590.

PUTTYROOT, (*Aplectrum hyemale*), an orchid known also as Adam-and-Eve found in woods and swamps from Ontario to Saskatchewan and Oregon southward. Each year the slender rootstock produces a solid globular bulb or corm. From this rises in late summer an oval, many nerved leaf, 4 to 6 in. long, persisting usually throughout the winter and succeeded the following summer by a flower-stalk, 1 to 2 ft. high, bearing a loose raceme of dull, yellow-brownish, purple-tinged flowers.

PUVIS DeCHAVANNES, PIERRE (1824-98), French painter, was born at Lyons, Dec. 14, 1824. He decided to become an artist after illness cut short his scientific studies, and worked under Scheffer, Delacroix and Couture. In 1850 he exhibited a *Pietà* at the Salon, but two years later his pictures were rejected by the jury. Thenceforth Puviss de Chavannes began producing some of his most notable works, among which are *Peace and War*, *Sleep*, *Ave Picardia Nutrix*, and *The Poor Fisherman*. His outstanding productions include the *St. Genevieve* murals in the Pantheon at Paris and the nine large panels painted from 1895 to 1898 for the Boston (Mass.) Museum. The artist died on Oct. 24, 1898.

PUYALLUP, a city in Pierce Co., western Washington, situated 9 mi. southeast of Tacoma. It is served by four transcontinental railroads. The chief interests of this region are berry raising, poultry and dairying. The city is surrounded by fine tracts of timber. Puyallup has lumber mills, canneries, a veneer plant, two box factories and other industrial establishments. The Western Washington Experiment Station of the State Agricultural College is located here. Ezra Meeker founded Puyallup in 1853. The city was incorporated in 1890. Mt. Rainier is 50 mi. to the southeast. Pop. 1920, 6,323; 1930, 7,094.

PU YI, HENRY (1904-), name adopted by Hsuan Tung, the last of the Manchu emperors of China and ruler of Manchukuo. He became emperor in 1908 at the age of four, with his father Prince Chun

as regent. The abdication agreement with the Republic of China in 1912 provided that the Manchu court might be maintained in the northern part of the Forbidden City in Peking (an area of about one sq. mi.), and that Hsuan Tung should retain the title of Manchu Emperor, although this title should cease with his death. In 1922 he took the name of Henry Pu Yi. In 1924 the "Christian General," Feng Yuxiang, expelled the young emperor, the empress and the court attendants from the Forbidden City. The Soviet Russian representative in Peking tried to persuade Feng to execute Pu Yi as the Russian Czar had been executed, in order to eliminate the danger of the restoration movement. Feng refused to do this, however. After a short stay at the Japanese Legation in Peking, Pu Yi and his family went to live in the Japanese Concession in Tientsin. For a number of years Pu Yi had a British tutor. Early in 1932 he was chosen, because of his ancestry, to head the newly established state of Manchukuo, and was inaugurated at Changchun, Mar. 9, 1932.

PUZZLE, any arrangement of letters, or parts, requiring ingenuity and cleverness to discover its meaning. Since the beginning of recorded history, puzzles have interested mankind. Puzzling was a religious rite with the Egyptians, one of whose goddesses was the Sphinx. David used an alphabetical acrostic in the Psalms 129. The hieroglyphs of the Phoenicians are connected with the rebus. Edgar Allan Poe is well known for his use of the cryptogram.

Puzzles of to-day are often combinations of words grouped together to form geometric designs. They include the square, diamond, pentagon, half square, star and hexadecagon, read horizontally and vertically, and the pyramid and rhomboid, where the horizontal words differ from the vertical. **CROSSWORD PUZZLES** are derived from this idea. Other puzzle shapes may merely assume a geometric outline. Verse puzzles include charades, enigmas, anacrostics, beheadments and anagrams.

PUZZOLAN. See **CEMENT**.

PYELITIS. See **UROLOGY: Infection**.

PYESHKOV, ALEKSYEY MAXIMOVICH. See **GORKY, MAXIM**.

PYGMALION, in Greek mythology, king of Cyprus, son of Cilix and grandson of Agenor, was said to have made an ivory statue of a beautiful maiden with which he fell in love. **APHRODITE** brought to life the image, who bore to him Paphos. The name given to the maiden was said to be Galatea, but this has no authority. Another Pygmalion was the son of Belus and brother of Dido.

PYGMY. See **RACES OF MANKIND: Negroid Group**.

PYLE, HOWARD (1853-1911), American illustrator and author, was born in Wilmington, Del., Mar. 5, 1853. After studying in Philadelphia and at the Art Students' League in New York, he was employed for several years in the art department of *Harper's Weekly*. Subsequently he became one of the leading American illustrators, specializing in books for children on historical subjects or in humorous

vein. Very often he was both author and illustrator. Pyle also taught at the Drexel Institute in Philadelphia and in 1907 he was elected to the National Academy. Among the works which he wrote and illustrated are *The Merry Adventures of Robin Hood*, *The Story of Sir Launcelot*, *Men of Iron*, *The Stolen Treasure*, and *The Wonder Clock*. Pyle died in Florence, Italy, Nov. 9, 1911.

PYLOROSPASM. See **DYSPEPSIA**.

PYM, JOHN (1584-1643), English statesman, was born in Somersetshire, in 1584. He was educated at Oxford and entered Parliament in 1614. During his long political career he rigorously upheld the rights of the people and was instrumental in bringing about the execution of the Earl of Strafford. Pym took an active part in the civil war between the king and Parliament. In 1642 the king tried to imprison the statesman on a charge of treason, but Pym received timely warning and escaped. He was made lieutenant-general of the ordnance in Nov. 1643, but died the following month.

PYONG YANG or **HEIJO-FU**, port and one of the oldest cities of Korea, in the main part a peninsula of Asia belonging at present to the Japanese Empire. The city is situated on a bluff of the north bank of the Tai-Dong River, 50 mi. from its mouth. It lies in a silk- and ginseng-growing district and there are coal and gold mines in the vicinity. Ki Tse, the traditional founder of Korea, was said to have established the capital here in 1122 B.C. Modernization has begun. There were 25,559 Japanese in the city in 1928. Pop. 1928, 116,207.

PYORRHEA, a slowly progressive disease of the gums, characterized by formation of pockets between the teeth and gums in which pus collects, receding, bleeding gum margins and loosening of the teeth. It is found in the middle and later decades of life, is slightly more common in males and is the most common cause of the loss of teeth. At least two forms are known: one, with abundant pus, rather shallow pockets, soft bleeding gums and deposits of tartar; includes about 90% of all cases; a second, in which gum recession involving most of the teeth is the only prominent feature, is rather rare. Local conditions which tend to favor the accumulation of food and other debris are most important in causing the first variety. The shifting and tipping of the remaining teeth following extractions, as well as developmental faults of tooth arrangement, produce spaces that are not easily cleaned. A similar effect is caused by fillings, inlays and crowns that have overhanging gum margins. The constant choice of soft foods requiring little or no chewing and derangements of the general health effect the resistance of the gums; this is true in diabetes.

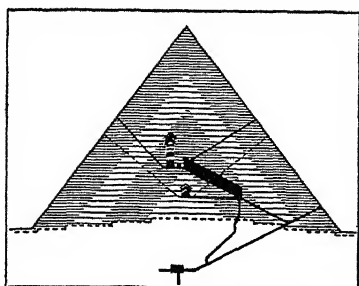
Bacteria are only of secondary importance in the causation of pyorrhea; many forms of pus producing organisms including streptococci are found in the pockets. But little is known about the second type. In many instances the victim has unusually well formed teeth highly resistant to decay, and practically

all cases exhibit peculiarities of metabolism that may be related to the glands of internal secretion.

By many, the pyorrhea pus pockets are thought to have a deleterious effect on the health. Prevention and treatment are naturally concerned with the control of the factors known to cause it. E. H. H.

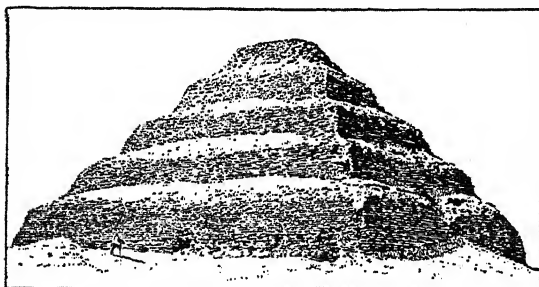
PYRAMIDON. See AMIDOPYRINE.

PYRAMIDS, monuments of ancient Egypt. Built at least 3000 B.C., between the 4th and the 12th dynasties, they tell the story of the Nile civilization.



SECTIONAL VIEW OF CHEOPS PYRAMID

The pyramids were tombs erected to the kings. Connected with them were temples which were always east of the pyramids. The pyramid was usually erected during the life of the pharaoh who was to occupy it. Of the several groups of pyramids the one at Giza is the most important. Here is found the Great Pyramid erected by Khufu of the Fourth Dynasty. This pyramid covers 13 acres, is 451 feet



STEP PYRAMID OF SAKKARA, BUILT ABOUT 3000 B.C.

high, has a slant of $15^{\circ} 15'$, contains 3,057,000 cubic yards of stone masonry, weighs 6,848,000 tons, and is composed of 2,300,000 blocks. There are some 75 pyramids in Egypt. The group at Dahshur is also well known. See GIZA.

PYRENEES MOUNTAINS, a lofty range of mountains about 240 mi. long, with an area of over 21,000 sq. mi. Forming the boundary between France and Spain they touch the Mediterranean at one extremity and the Atlantic at the other. Between these terminations there are only a few passes practicable for vehicles, two of which are the Col de Somport, extending from Saragossa to Oloron and the Col de la Perche, connecting the valleys of the Segre and Tet rivers. The three railroads running from France to Spain are roundabout from necessity so that the

sea is the route of the principal trade between them. In the central section, which contains the loftiest eminences, the Pyrenees present a succession of unconnected and unsymmetrical ranges, traversing the distance between the Mediterranean and the Atlantic at an angle. The highest elevations are the Maladetta (Pic Nethou, Pico de Aneto), the culminating point, 11,168 ft.; Mont Perdu, 10,994 ft.; Pic d'Estats, 10,305 ft.; Pic de Montcalm, 10,103 ft.; Pic de Vignemale, 10,820 ft.; Pic de Maupas, 10,200 ft. Granite superimposed by masses of chalk and sandstone forms the chief rock constituent of the range. The snow-line of the Pyrenees occurs about 1,000 ft. higher than that of the Alps, at an elevation of about 9,000 ft. Sterility and desolation characterize a great part of the Pyrenees; in the western sections, however, which receive plenty of rainfall, a luxuriant vegetation is produced. The Adour, Garonne and Aude, flowing north, and the Llobregat and numerous affluents of the Ebro, flowing south, are the principal rivers which have their headwaters in these mountains. In the upper valleys, many streams terminate in cirques and into some of these waterfalls descend from breathtaking heights. The effect is frequently magnificent. The Pyrenees abound in thermal and mineral springs and as a consequence are replete with resorts, among which are Pau, Tarbes, Bagnères-de-Bigorre and Bagnères-de-Luchon.

PYRENEES, PEACE OF THE, a treaty negotiated by France and Spain in 1659, closing a long period of rivalry, and complementary to the general European settlement included in the PEACE OF WESTPHALIA, 1648. Richelieu, head of the administration in France, 1624-42, resolved to establish French ascendancy in Europe. This end could be attained only by humbling the HOUSE OF HABSBURG which ruled over both Austria and Spain. The mortal weakness of Spain, long veiled by the magic of the names Charles and Philip, was by 1640 quite apparent. Administration of the poverty-stricken country had fallen into incompetent hands. Against Spain the diplomacy of the wily Richelieu was even more deadly than his armies. The Portuguese were encouraged to declare their independence, 1640, and the Catalans were incited to revolt. In the Battle of Rocroi, 1643, the long-standing reputation of Spanish infantry for invincibility was shattered. Three years later France for the first time won naval supremacy over the western Mediterranean, and soon thereafter the Neapolitans rose to throw off the Spanish yoke.

By the Peace of Westphalia, Mazarin, Richelieu's pupil and successor, made victorious peace with Austria; but war with Spain, prolonged by civil strife in France, continued for several years. Finally, in Nov. 1659, peace was negotiated at the Bidassoa on the Franco-Spanish frontier. To the south France gained Roussillon and Cerdagne, and to the northeast, towns in Artois, Flanders, Hainaut and Luxemburg. France assented to the partial restoration of the Duke of Lorraine, ally of Spain, to his duchy. The Great Condé, who had fought with the Spaniards against France,

was fully pardoned. A Franco-Spanish alliance was cemented by the marriage of Louis XIV and the Spanish Infanta Maria Theresa, who renounced all claims to the Spanish throne in return for a dowry of 500,000 crowns, which was never paid. The territorial acquisitions greatly improved the boundaries of France, and the victorious peace with Spain markedly enhanced her prestige. Spain not only had failed in the preceding century to gain mastery over Europe, but now had failed to maintain a position of parity with France. E. F. C.

PYRETHRUM (*Chrysanthemum coccineum*), a popular garden perennial of the composite family, closely allied to the feverfew. It is a native of southwestern Asia with many floral and foliage varieties in cultivation. The smooth sparingly branched stems, 1 to 2½ ft. tall, grow in clumps, bearing finely cut leaves and large solitary flower-heads, sometimes 3 in. across, with long white, pink, crimson or dark red rays. From the dried flower-heads of this plant and also from those of the Dalmatian species (*C. cinerariaefolium*) is prepared the well-known pyrethrum powder used as an insecticide.

PYRGOS, a town in Greece on the west coast of the Morea. The chief stop on the rail line connecting Patras with Kalamata, it is also joined by rail with its harbor, 7 mi. away. Pyrgos is the trading point for the currants, wine and oranges for which the district is well known. About 12 mi. to the east are the Olympian ruins. Pop. 1928, 14,200.

PYRHELIOMETER, a delicate instrument designed to measure the heat of the sun's rays.

PYRIDINE, a colorless liquid, having the formula C_5H_5N , originally obtained from bone oil, but now derived from coal tar. It resembles benzene in structure with one CH group replaced by nitrogen. Its boiling point is 115.3° C. It reacts as tertiary 'e, forming stable salts with acids. Very stable to oxidation, but hydrogenation converts it to piperidine. Many alkaloids are related to pyridine.

PYRITE, a brass yellow mineral of metallic appearance, a sulphide of iron, which is sometimes used as an ORE of both sulphur and iron. Most frequently it occurs as a GANGUE, or waste mineral, in many deposits of metalliferous ores. It is often popularly called "fool's gold" because those unskilled in mineralogy sometimes mistake it for gold. Pyrite is brittle, however, while gold is malleable, and the color is also slightly different. Pyrite crystallizes in the ISOMETRIC SYSTEM. It weathers to LIMONITE.

Pyrite is common and widespread, a frequent constituent of igneous rocks, occurring also in veins and distinct masses. Important commercial deposits are located in Norway, Germany, France, Italy, and Spain. It has also been mined in New York, Virginia, and Massachusetts. Sometimes pyrite carries small amounts of copper or gold, and may be mined for them.

The name is from the Greek for fire, in allusion to the sparks it emits when struck. See also GOSSAN; WEATHERING; OCHER; ORE DEPOSITS.

PYROGALLOL, a poisonous solid in the form of

colorless needles, also known as pyrogallallic acid or trihydroxybenzene. It has the formula $C_6H_3(OH)_3$ and is prepared by heating gallic acid. Its melting point is 133° C.; it is odorless, but has a bitter taste. It is very soluble in water and organic solvents; is easily oxidized, especially in alkaline solutions which are used for analytical determination of oxygen. It is used in photography, reducing silver and cupric ions.

PYROLIGNEOUS ACID. See WOOD DISTILLATION.

PYROLUSITE, a soft, iron-black to dark steel-gray mineral, the dioxide of manganese, which serves as a manganese ORE. It is extensively worked in Germany, Australia, and India. There are deposits in Vermont, Massachusetts, Virginia, and elsewhere.

Pyrolusite serves as an oxidizing agent in chemical industries, a drier in paints, a decolorizer in glass, a coloring material in pottery, and in electric batteries. See also ORE DEPOSITS.

PYROLYSIS, the transformation of a chemical compound into one or more other substances through the agency of heat alone. Usually the term is applied to organic compounds, but some inorganic compounds undergo pyrolysis. Thus, when sodium bicarbonate is heated, sodium carbonate results. Similarly, ammonium nitrate pyrolyzes into nitrous oxide; disodium phosphate into sodium pyrophosphate; mercuric oxide into mercury and oxygen.

With organic compounds, pyrolysis includes not only decompositions or breakdowns into simpler substances, but also rearrangements wherein no gain or loss of atoms occurs, or even includes building-up processes such as polymerizations. For such reactions to occur, a chemical bond (C-C, C-H, C-O, etc.) must have been severed or activated by heat. The following pyrolyses are illustrative.

At 1000° C., methane yields carbon and hydrogen. At 700° C., acetone changes into methane and ketone. Starch is converted into dextrine by a hot flatiron. At petroleum refineries, oils are "cracked" into gasoline by various patented processes (see CRACKING PROCESSES). Modern familiarity with commercial diphenyl is due to its pyrolytic preparation from benzene. Polymerizations of acetylene into benzene, or of isoprene into synthetic rubber (see RUBBER, SYNTHETIC) illustrate the building-up processes. C. D. H.

See C. D. Hurd, *The Pyrolysis of Carbon Compounds*.

PYROMETER, an instrument primarily used for measuring high temperatures, though some can be used also for low temperatures. Their importance in industry has increased enormously during the past few years, particularly in the steel industry. The demands of automobile manufacturers for steel of high quality and absolute uniformity necessitated standardizing the various heat treatments. This, in turn, required the development of certain accurate methods for measuring high temperatures. Other industrial processes have led to the development of other special types of pyrometers.

Besides specially designed, high-range, mercury thermometers, such as flue-gas thermometers, the

principal types of pyrometers may be classified as thermocouples, resistance thermometers, radiation pyrometers and optical pyrometers (*see separate articles on these subjects*). Less important methods, like the specific-heat pyrometer and the Seger fusible cones, as well as several others, are now more or less obsolete. Thermoelectric pyrometers, resistance thermometers and radiation pyrometers can be installed either as indicating or as recording instruments. Optical pyrometers as a rule are indicating instruments.

In choosing the pyrometer best suited to any particular use, a number of different, and sometimes contradictory, factors must be considered, such as range of temperatures to be measured, sensitiveness desired, allowable time-lag in indications and cost. Platinum resistance thermometers will give very accurate results up to $1,000^{\circ}\text{C}$. or even $1,200^{\circ}\text{C}$. but they are very expensive. Below 150°C ., nickel resistance thermometers are quite satisfactory, unless great precision is desired. Platinum-rhodium thermocouples are very reliable in measuring temperatures between 300°C . and $1,600^{\circ}\text{C}$., but again the cost is high. "Base metal" thermocouples, e.g., nickel-nichrome and chromel-alumel thermocouples, are frequently used in industrial processes over a narrower range of temperatures. Radiation pyrometers cannot be used satisfactorily below 500°C . Above, $1,500^{\circ}\text{C}$. an optical pyrometer is preferable. Optical pyrometers have a useful range of from 600°C . or 700°C . to the highest attainable. *See also THERMOMETRY*. W. W. S.

PYROPHORIC SUBSTANCES, substances which possess the peculiar property of igniting spontaneously when exposed to the air at ordinary temperatures. Many solid materials, when pulverized very finely, so that an extremely large area is exposed to the air, are pyrophoric. When the oxides of iron, cobalt and nickel are reduced by hydrogen at low red heat, the metal is left in such a finely divided state that it becomes incandescent on exposure to the air. Numerous salts also possess the property, such as lead citrate and tartrate. If these are ignited in a glass tube and left to burn until all gaseous matter is evolved and are exposed to the air after cooling, they catch fire instantly. Other pyrophoric substances include liquid phosphene, P_2H_4 , and such organo-metallic compounds as cacodyl, trimethylstibine, and zinc diethyl. One of the first known pyrophoric substances was Homberg's pyrophorus, which was prepared by heating alum with a carbonaceous material such as lampblack. This peculiar property of spontaneous inflammability is explained by the fact that the substances, when in a very finely divided state, have a capacity for condensing air within their pores, causing a rise in temperature, and to the fact that the substance in that state has a greater area exposed to the oxidizing action of the air.

PYROTECHNICS. *See FIREWORKS*.

PYROXENE, one of a group of rock forming minerals known as the pyroxenes. They are of the greatest importance in the IGNEOUS ROCKS and are often prominent in the metamorphic ones. In color

they vary from white, through green to black. Common pyroxene is dull greenish-black. The minerals included in the group are hypersthene, diopside, pyroxene, augite, spodumene and aegirite. All are silicates of two or more of calcium, magnesium, iron, sodium, and aluminum. They crystallize in the MONOCLINIC SYSTEM, except hypersthene, which crystallizes in the ORTHORHOMBIC SYSTEM. They possess prismatic cleavage at 87 and 93 degrees, which distinguishes them from the hornblendes which they resemble. Rocks composed almost entirely of pyroxene are known as pyroxenites. *See also HORNBLLENDE; CHLORITE; SERPENTINE; TALC; PETROLOGY*.

PYROXYLIN, a term formerly used to designate all plastic materials made from nitrocellulose, now restricted to nitrocellulose of a lower degree of nitration such as nitro-cotton for lacquers, celluloid, artificial leather dope, etc. Gun cotton and smokeless powders are thus generally excluded from its more modern meaning. *See also NITROCELLULOSE; CELLULOID*.

PYRRHA. *See DEUCALION AND PYRRHA*.

PYRRHOTITE, a metallic looking mineral of slightly reddish bronze color. A sulphide of iron, it contains more iron than PYRITE, is slightly magnetic, and crystallizes in the HEXAGONAL SYSTEM. As a GANGUE mineral, it is found in some sulphide ORE DEPOSITS, especially with pentlandite, a nickel sulphide, and the copper-iron sulphide, chalcocopyrite. Pyrrhotite occurs in Germany, Norway, Brazil, the United States, and in nickel and copper deposits of Canada.

PYRRHUS (c. 318-272 B.C.), King of Epirus, was the son of Æacides, who claimed descent from Pyrrhus, son of Achilles. He came to the throne of Epirus at 12 years of age, and was deposed several years later. Joining his brother-in-law Demetrius, he fought for the latter at Ipsus in 301, and was afterward sent as a hostage to Egypt. There he married Antigone, the step-daughter of Ptolemy Soter who aided him in regaining his kingdom. An unsuccessful campaign in Macedonia followed, after which Pyrrhus crossed over to Italy with his army to assist the Tarentines in their war against the Romans. A terrific battle, fought near Heraclea (280 B.C.), ended in complete victory for Pyrrhus, but not until he had himself suffered frightful losses. Hence the phrase "a Pyrrhic victory." In 279 he was again victorious over the Romans at Asculum in Apulia. The next year, he crossed into Sicily, driving out the Carthaginians. Three years later he returned to Italy, and was crushingly defeated near Beneventum in 275. He then became engaged in several wars in Greece, and was killed at Argos. He ranks among the great warriors of antiquity.

PYRRHUS or **NEOPTOLEMUS**, in Greek mythology, son of ACHILLES and Deidameia. After his father's death Pyrrhus joined the Greek forces against Troy and was one of the heroes who entered the city in the wooden horse. During the siege he slew PRIAM, and afterwards married ANDROMACHE, settling in Epirus. Later, returning to Phthia to help

PELEUS regain his throne, he married HERMIONE, daughter of MENELAUS. Pyrrhus was killed at Delphi either by the Delphians or ORESTES, lover of Hermione.

PYSANDU, a city of Uruguay and capital of the department of the same name, situated about 214 mi. northwest of Montevideo. It is connected by railway with the Brazilian frontier, and on the south with Buenos Aires by steamer. Its chief industry is meat packing, and there are some lumber and flour mills. A meteorological observatory is located here. It has modern improvements. Est. pop. 1930, 37,000.

PYTHAGORAS (c. 528 B.C.), Greek philosopher and mathematician, was born at Samos during the first half of the 6th century. He was the pupil of Pherecydes and probably also of Anaximander. Pythagoras traveled extensively in the East, spending considerable time in Egypt. During his travels he became familiar with the cults and science of the Orient. In 520 B.C. he returned to Greece and founded at Crotona, in Magna Graecia, a semi-religious order which had considerable political influence in its day. In its ideals and mode of life it was quite Buddhistic in character. Philosophically the school was one of the mediators between Heraclitus and the Eleatics, the concept of number being its foundation. From the opposition between odd and even numbers much attention was given to the principle of dichotomy. Metempsychosis was also one of the central teachings of the school. In geometry the name of Pythagoras has become familiar to all in connection with the famous Pythagorean proposition.

PYTHAGORAS OF RHEGIUM, an important Greek sculptor of the 5th century B.C. Born at Samos, he settled at Rhegium in Magna Graecia. He specialized in statues of athletes, developing easy natural poses and lifelike details, to replace the archaic stiffness. None of his originals survive. But the *Apollo on the Omphale*, at Athens, and the *Choiseul-Gouffier Apollo*, in the British Museum, are considered copies of his statue of the boxer Euthymus.

PYTHAGOREAN THEOREM, the theorem which states that the sum of the squares on the two, or shorter, sides of a right, or right-angled, triangle is equivalent to the square on the hypotenuse. Tradition assigns the first proof to Pythagoras (c. 540 B.C.); but no writer earlier than the first century B.C. asserts this fact. The proposition is usually numbered 47 in Book I of Euclid's *Elements* (Geometry), although this number varies in different manuscripts. It was known for special cases (as of $3^2 + 4^2 = 5^2$) long before the time of Pythagoras, but no formal proof seems to have been attempted. See GEOMETRY; PYTHAGORAS.

PYTHIA, in Greek mythology, the maid or woman who gave the responses of the oracle at Delphi. She would first drink from the holy spring and chew laurel leaves, then sit on her tripod within the shrine, whence she gave utterance to the god's decrees. Her words were taken down in verse by the priests. At one time there were three Pythias who relieved each other, so constant were the calls made upon them.

PYTHON, a term more generally applicable to any member of the sub-family *Pythoninae* (with one exception Old World snakes), but specifically referring to species of the genus *Python*. The 10 species of this genus include forms equaled in size only by the South American anaconda. Although of great size, pythons possess no poison apparatus, are seldom dangerous to man, and, therefore, should not be greatly feared. They are widely distributed over Africa and the Indo-Australian and Pacific regions to the Philippines. Pythons feed largely on mammals and birds for which they lie in wait. They suffocate their prey by constriction, literally squeezing out the breath. The victim is not, as often supposed, noticeably crushed or mutilated by great pressure. A large python finds no difficulty in swallowing an animal weighing 75 lbs. Abundant saliva is secreted during the process and acts as a lubricant. The snake really pulls itself over its prey. Numerous white-shelled eggs are laid and guarded by the female until hatched. The reticulated python (*P. reticulatus*), of the Indo-Chinese and Malayan regions, is the largest species, reaching a length of 30 ft. The Indian Python (*P. molurus*) is a well-known form from India and Ceylon, while *P. spilotes*, the carpet snake, inhabits Australia and New Guinea. In Africa, the rock python (*P. sebae*) and the west African python (*P. regius*) are familiar species. C. H. P.

PYTHON, in Greek mythology, a serpent produced from the mud left by the flood in the time of Deucalion. It lived in caves near Delphi where it delivered oracles until slain by APOLLO.

PYX (from Greek words, meaning box or chest), an ecclesiastical term for the sacred vase or receptacle in which the Host is reserved. Its form is generally cylindrical, with perhaps a conical top.

In modern times it is much smaller than formerly, and is often made round and flat like a watchcase for convenience in carrying the BLESSED SACRAMENT to the sick.

PYXIE (*Pyxidantha barbulata*), a dwarf, creeping, evergreen shrub of the diaspensia family, called also flowering moss. It is found in dry sandy pine barrens from southern New Jersey to North Carolina. The branching densely leafy stems, growing in mats or patches, bear very numerous white or pinkish flowers at the ends of the branches and podlike fruits with minute seeds.

PYXIS (gen. *Pyxidis*), the ship's compass, a very small constellation between Puppis and Hydra. See STAR: map.



COURTESY M. M. OF ART
13TH CENTURY PYX, MADE OF
COPPER AND GILDED WITH
BRONZE

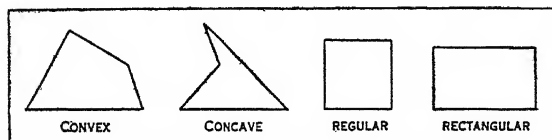
Q

"Q," pen name of the British author, SIR ARTHUR THOMAS QUILLER-COUCH.

QUACK GRASS (*Agropyron repens*), a vigorous perennial called also couch-grass and quitch grass. It is a native of Europe and Asia, widely naturalized in North America, and often an exceedingly troublesome weed. The smooth stems, rising from long, many jointed, creeping rootstocks, bear numerous flat, slightly hairy leaves and a long narrow flowering-spike composed of many spikelets. The plant spreads by means of its underground rootstocks and when once established is difficult to eradicate.

QADI. See CADI.

QUADRILATERAL, a polygon of four sides. A square is a regular quadrilateral. Among the proper-



TYPES OF QUADRILATERALS

ties of the quadrilateral are the following: The sum of the interior angles is 360° . The lines joining in order the midpoints of the sides of a quadrilateral form a parallelogram. See POLYGON.

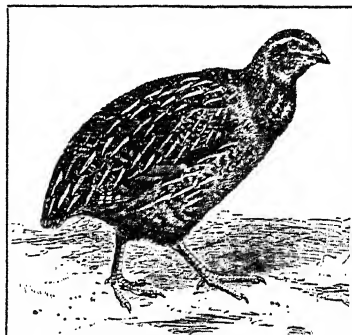
QUADRUPLE ALLIANCE. On Nov. 20, 1815, the four Great Powers that had defeated Napoleon, namely England, Austria, Prussia and Russia, signed a secret treaty of alliance against France. This alliance has subsequently been called the Quadruple Alliance. The treaty recorded the solemn obligation of the four Powers to take such measures as they deemed necessary to preserve the general tranquillity of Europe and of their respective states against the menace of renewed revolutionary activities. Aimed particularly against France, it stated explicitly that the contracting Powers would be bound to use military intervention in the event that France threatened the existing order of things established there by the Settlement of 1815. Moreover, the four allies agreed to meet at periodic intervals to consult upon their common interests and to consider measures "most salutary for the repose and prosperity of nations, and for the maintenance of the peace of Europe." This idea of an international policy to keep the peace in Europe was defeated by the unwillingness of England to subordinate her national aims to the international program of the allies and, more emphatically, in the successful revolts of the Spanish-American colonies and Greece.

QUAESTOR, Roman officers created at a very early date as assistants to the CONSULS, charged with supervision of finances, business, archives, military

and naval supplies, when they accompanied the consuls into the field; also as pro-quaestors, the main business assistants of the provincial governors. Under the Empire, imperial quaestors performed various personal functions of the Emperor. The number varied from time to time.

QUAGGA. See ZEBRA.

QUAIL, one of several small game birds, such as certain Old-World partridges and francolins; in the United States, a member of the exclusively American



EUROPEAN MIGRATING QUAIL
Coturnix communis

family *Odontophoridae*, which also includes a great variety of mostly tropical species. All are terrestrial birds of prairies and open lands, which have multiplied with the increased opportunities offered them by



CALIFORNIA QUAIL

the clearing away of forest and the extension of cultivated fields and pastures. These are the game birds most prized by skillful sportsmen, who hunt them by the aid of bird-dogs trained to find the birds by their scent. The quail of the east (*Colinus virginianus*) is known in the North as Bobwhite, from its whistly

call, and in the South as partridge. Bobwhites nest on the ground, laying white eggs, and form small flocks or coveys that live together except during the nesting season, feeding mainly on weed seeds, grain and insects.

The Pacific Coast has two distinct and beautiful quails; the California or valley partridge and the mountain or plumed partridge; the former has a black throat and cap, bordered with white, and a forward-nodding plume on the head; the latter has head and neck gray, and a long, slender plume falling from the head over the grayish back. All American quails have a pleasant, whistling call-note, which in the eastern quail imitates its name ah-bob-white. E. I.

QUAIL SHOOTING, a variety of bird shooting popular in the United States. Although called partridge in the South, where they are very abundant, quail are much smaller than the partridge or ruffed grouse of the northern states and Canada, and more easily shot. In the North these birds are called bobwhites because of their whistling call. There are many species and sub-species of quail, all about the same size, though the plumage varies widely in birds of the East and the West.

Quail inhabit open meadows and are often found along the edge of grain fields. They are shot over dogs, pointers and setters being used. When hunting, one should start early in the morning, as the birds will not fly as far then as later. The ground must be hunted closely, giving the dog plenty of time. Quail huddle together and lie very close, so that unless a dog runs near he may not scent them. Although quail are fond of sunning and dusting themselves in open cultivated fields, in the middle of the day they seek the sides of meadows and high grass, especially where there is water. When flushed, they make a swift, rather low flight. The average load for quail is $3\frac{1}{2}$ drams of smokeless powder and $1\frac{1}{8}$ ounces of No. 7 or 8 shot.

See D. W. Huntington, *Our Feathered Game*, 1903.

QUAITSO, a North American Indian tribe, belonging to the Salishan linguistic stock. They lived on the coast of Washington to the north of the Quinault to which group they may have belonged.

QUAKERS. See FRIENDS, SOCIETY OF.

QUAKERTOWN, a borough in Bucks Co., southeastern Pennsylvania. It is situated 40 mi. north of Philadelphia and is served by the Reading Railroad. Corn, wheat and potatoes are the principal crops of the vicinity. Clothing, cigars and silk are the principal manufactures. The site was settled by Quakers in 1700 and the town contains some interesting landmarks, such as a slave clearing house, Liberty Hall and Red Lion Inn. Pop. 1920, 4,391; 1930, 4,883.

QUAKING ASP, a name given to small species of Poplar with leaves on such slender stalks that the blades tremble with the gentlest motion of the air. See ASPEN.

QUAKING GRASS, a genus (*Briza*) of annual or perennial grasses, several of which are cultivated for their attractive flowering spikelets. There are

about 18 species, natives of the Old World and temperate South America, three of which have become naturalized in the United States. They bear flat or rolled leaves and showy, usually open clusters of slender-stalked, drooping spike-lets which tremble in the gentlest wind. The rattlesnake grass (*Glyceria canadensis*) is sometimes called the tall quaking grass.

QUALITY OF MUSICAL SOUNDS. See MUSICAL SOUNDS.

QUANANICHE, a small variety of the Atlantic SALMON (*Salmo salar ouananiche*) found in the Saguenay River, Lake St. John and other lakes in Quebec. It weighs usually about 2 lbs. and is noted for its very gamy qualities. When hooked, it leaps high from the water often several times in succession.

QUANDANG NUT, the seed of a small Australian tree (*Fusanus acuminatus*) of the sandalwood family. It is borne within a fleshy, edible fruit, known as the native peach and somewhat used in preserves. The nut kernel, enclosed within a round yellow shell marked with numerous deep pits, is highly prized for its flavor.

QUANTITY THEORY OF MONEY, the theory that an increase or decrease in the quantity of money in circulation will produce an equal percentage increase or decrease, on the average, in the prices of all goods exchanged for money, other things remaining the same.

A very cursory analysis of this crude statement of the theory reveals its deficiencies. The quantity of money in circulation means the total number of units of standard, subsidiary, and token money, as well as BANK NOTES and CHECKS against bank deposits, used in exchanging goods. Anything which performs the money function of effecting exchanges of goods is money. Direct BARTER and exchanges of goods by book credits may be ignored because the total amount of such exchanges is relatively insignificant.

The prices of all goods exchanged for money include not only the prices of all material commodities, but also real estate, securities and direct services as well, such as railway and street car fares, domestic and other direct personal services. Index numbers of wholesale prices are made from commodity prices only, excluding the three last named categories of goods, hence, such indexes are defective measures of changes in the prices of all goods.

Other things remaining the same is an assumption contrary to fact made by all cautious classical economists. Of course, other things do not, and cannot possibly remain the same.

Consideration of the Equation of Exchange, $MV = PT$ will help to a clearer understanding of the quantity theory. In this equation, M is the quantity of number of units of money of all kinds in circulation; V is the velocity of circulation which means the number of times each unit of money, the dollar in the United States, changes hands in effecting exchanges of goods during the period considered; P is, strictly speaking, the average price per quantity unit of all commodities and services taken in all their conglomer-

erate and incomparable heterogeneity; T is, theoretically, the aggregate quantity of all units of each commodity and service exchanged for money during the period under consideration, that is, the total number of bushels of potatoes, hair cuts, acres of farmland, street car rides, bathtubs and the thousands of other things that are sold and bought.

As it is impossible to construct an average price for this mélange of goods expressed in such utterly incommensurable units and to average the prices per unit would overweight the importance of commodities with high unit prices, like platinum per ounce and correspondingly underweight those with low unit prices like bread per pound, it is advisable, in any statistical studies of the Equation of Exchange, to employ as the units for measuring goods not the ordinary units—pounds, bushels or acres, but the dollar's worth at a certain period called the base period. Then P becomes the index number of prices relatively to that base.

The equation is not a mathematical proof of the quantity theory of money. The equation itself gives no hint that M has a more dominant influence than P, or V, or T.

The evidence for the quantity theory rests upon logical and statistical analyses of the sequences in the changes which occur in the elements included in the equation.

A priori it is obvious that M must be more important than any other element in the equation when we consider that money is the medium of exchange and the common standard in terms of which the prices of all goods are measured. A change in M, unless exactly counterbalanced by a reverse change in V, must necessarily affect prices, and exchanges of all goods.

Statistical analyses corroborate the quantity theory in a general way. M is more subject to change than T. The volume of currency M can be and often has been changed very quickly—almost over-night, whereas the total volume of trade T varies much more slowly and regularly. Moreover, the short-time fluctuations in T are usually matched by corresponding fluctuations in V. Except for these short-time fluctuations, V fluctuates very little and slowly. In the long run, V is fixed by the convenience of the public, which is ever trying to adjust the balances carried in pocket and bank to the expenditure. So with V and T substantially fixed relatively to each other, except for a slight secular change, P varies, for the most part, with M. In general, but not inevitably, the casual connection has run from money supply to price, although all the other elements are affected in varying degrees and even the reverse train of causation does obtain sometimes, for example, during and after the World War and other periods of very rapid price inflation when high and rapidly increasing prices, caused originally by increases in M, stimulated in turn the issuance of bank notes and deposit currency to enable purchasers to pay the higher prices, thus forming a vicious circle. But

such reverse causation applies to transition periods, not to ideal equilibrium.

I. F.

BIBLIOGRAPHY—Irving Fisher, *The Money Illusion*, J. H. Rogers, *The Process of Inflation in France*, E. W. Kemmerer, *Money and Credit Instruments in Their Relation to General Prices*

QUANTUM MECHANICS. See LINE SPECTRUM.

QUANTUM THEORY, a hypothetical law of physics pertaining to the properties of the quantum, the smallest unit of energy in existence. It has two fundamental propositions. The first of these states that radiations, such as HEAT, LIGHT, X-RAYS and GAMMA RAYS, consist of bundles of energy, called quanta or PHOTONS, whose energy content depends directly on the FREQUENCY of the radiation. The amount of energy or size of these photons increases from the heat to the gamma rays in the order named above. For example, a quantum of yellow light contains 3.33×10^{-22} ergs, while a penetrating x-ray contains 9.4×10^{-18} ergs (see ELECTROMAGNETIC SPECTRUM). If E represents the number of ergs per quantum and ν the frequency of the radiation, this law may be stated as $E = h\nu$, where h is Planck's constant, 6.55×10^{-27} erg-sec.

This theory was first advanced by Planck to explain BLACK BODY RADIATOR and has met with signal success in explaining a large number of physical phenomena. It explains what happens when radiant energy impinges on PROTONS, ELECTRONS, ATOMS and MOLECULES, and vice versa. Among the phenomena which it explains are the following: the velocity of electrons ejected under the action of light, photo-electric effect (see PHOTO-ELECTRICITY); the interaction of x-rays with electrons, COMPTON EFFECT; the scattering of light by molecules, RAMAN EFFECT; and radiation from atoms and molecules (see RADIATION, THEORY OF).

The second part of the quantum theory was advanced by Bohr in 1913, and states that the moment of momentum of an electron in an atom is an integral multiple of $h/2\pi$. That is to say, the electrons in an atom can occupy only certain definite energy levels. It was expanded by Sommerfeld and Wilson to a more general form to account for the spectra emitted by hydrogen and other more complicated atoms. It has resulted in many new discoveries and has virtually revealed the internal structure of the atom. See also WAVE MECHANICS.

J. B. H.

QUAPAW, a southwestern Siouan Indian tribe which lived in Arkansas. The Sioux people are supposed to have separated at some early time. The Quapaw went down the Mississippi River and the Omaha group, including the Omaha, Kansa, Ponca and Osage, went up the Missouri River. There is a close linguistic and ethnic connection between the tribes of the two divisions. The Quapaw were visited by De Soto's expedition during 1539-43 and in 1673 by Marquette and Joliet who referred to them as the Akansa. They were mound-builders and sometimes placed their principal buildings on elevations which are recorded as sometimes 40 feet in height. Villages

were substantially built and frequently walled. An early missionary describes the Quapaw as "civil, liberal and of a gay humor" in contrast to the stern morose dispositions of the northern Indians.

QUARANTINE, derived from the Italian word "quaranta," meaning forty, and referring to the forty days of detention of ships carrying cases of infectious diseases in the old sanitary system. It is applicable to-day in the administrative control of a number of diseases. The modern substitute for the term is now "sanitary regulations," yet one is constantly confronted with the use or threat of quarantine regulations in human diseases, in animal diseases or in plant diseases. In modern times of travel with the airplane, the fast ship and train, many diseases may be transported hither and thither, to be spread likewise either by the healthy carrier or the missed case, so that any quarantine regulation may be unwisely prohibitory. The limitation of freedom of movement of persons or animals who have been exposed to disease is generally that period equal to the period of incubation. Susceptibility or immunization to the disease also plays a part, so that fixed rules are difficult to make and to enforce. For instance, a patient with measles may be long afterward capable of transmitting the disease; while recent successful vaccination against smallpox would eliminate further detention. Proper surveillance or isolation must be practiced and applied to our known knowledge of the disease. The problem may become manifold and the value of the epidemiological sections of the League of Nations and that of the U.S. Public Health Service cannot be overestimated in standardizing and formulating quarantine regulations or in the dissemination of information as to the presence or spread of disease.

Quarantine regulations may be spoken of as local (city, county or state), interstate or maritime. Generally, local regulations must coincide with those of the state, but they may be even more comprehensive. Interstate quarantine regulations are considered a function of the U.S. Public Health Service. Each health official exchanges information or consistently studies the Public Health Reports prepared by the Federal authorities; and the old spectacle of one state being quarantined by another because of the presence of yellow fever has been eliminated because scientific investigation and control prevail.

The terms, isolation and quarantine, are frequently used by many health officials interchangeably. Technically speaking, quarantine means detention of the well for varying incubation periods, and isolation means control of actual cases of illness or of carriers.

The transitional periods of public health have focused attention on epidemic diseases of worldwide prevalence or their migration to new soil. The defense of countries or nations or continents to disease is known as maritime quarantine. Plague-infected rats at ports of commerce are exterminated; the breeding areas of mosquito vectors of diseases such as yellow fever and malaria destroyed; safe and unpolluted water supply used as a protection against typhoid

and cholera; sanitation of food supplies controlled, especially raw vegetables, and medical and laboratory examinations of food handlers made to prevent amebic dysentery; clean environmental conditions against lice to eliminate typhus fever and a vaccinated community to prevent smallpox. If all of these measures could be carried out or supervised by an active, scientifically trained health department, maritime quarantine measures would be entirely unnecessary. Maritime quarantine, so far as the United States is concerned, is enforced against cholera, yellow fever, plague, typhus fever, smallpox, leprosy and, more recently, epidemic cerebrospinal fever. The time of the detention is in accord with the known or accepted incubation period and counted from the last exposure. Well equipped quarantine stations are maintained at strategic ports. Communication with ships in quarantine is forbidden; the vessels themselves disinfected, the crew and passengers detained until suitable laboratory examinations, when necessary, can be completed, and the actual source of the disease traced, particularly if contracted in a port or on shipboard.

All vessels, domestic or foreign, touching United States ports from abroad, are required to secure from consuls Bills of Health; submit statement of health conditions aboard ship and the number of passengers discharged and embarked at various ports. The boarding quarantine officer will examine the crew and passengers and if no communicable disease is aboard as considered under the regulations, the vessel is discharged with a so-called "pratique." In addition, whether ships are rat-proofed or not, if they are from plague-infected ports, de-ratization by fumigation is mandatory. This has, in the past, caused delay and seemingly unnecessary expense to shipping. What is desirable, of course, are rigid measures which convey a maximum of protection with a minimum of interference and expense. But there is no doubt that, under the best of conditions, maritime quarantine not infrequently fails of the *ideal* goal.

Local quarantine can be considered only in a general way. The simultaneity of occurrence of cases of a disease in a given community may indicate close relationship, but often this is far from the rule. "Stamping out" the disease is fraught with administrative difficulties. Contagion lines may be determined and control measures used against them, but the healthy carrier offers additional problems, especially in typhoid, diphtheria and the epidemic diseases of the central nervous system. Theoretically, isolation offers an ideal method for control. But all cases are not reported or, oftentimes, recognized. Therefore, the practicability of isolation varies. Likewise, the regulations vary, as, for instance, cases of yellow fever or malaria or smallpox may be isolated; typhoid bacillus carriers and syphilitics controlled and isolated, but the tuberculous or the leprosy who are careful may be allowed more or less freedom. To quarantine or isolate properly and early, is to neutralize the spread of disease. Therefore, communicable disease hospitals, especially for diphtheria, smallpox, scarlet fever, etc.,

have become effective public health agencies. Likewise, there are many perplexing quarantine problems in the household.

Notwithstanding the many limitations to quarantine procedure, it is the one public health measure most used by the health official and, as our knowledge of disease progresses, will become necessarily more effective. See also CARRIERS OF DISEASE, EPIDEMIOLOGY.

J. C. G.

QUARLES, FRANCIS (1592-1644), English poet, was born near Romford, Essex, and baptized at Romford, May 8, 1592. He was educated at Cambridge and studied law. After several years abroad he went to Ireland as secretary to Bishop Ussher, primate of Ireland, and in 1639 was appointed chronologer to the city of London. His popular *Divine Emblems* consisted of "Designs," with paraphrases from Scripture passages and verses of his own. Some of the "designs," however, he borrowed from Herman Hugo. The *Enchiridion of Meditations*, contains some of his best work. Quarles wrote pamphlets upholding the Royalist cause, and his property was confiscated. Thereafter his health failed, and he died in London, Sept. 8, 1644.

QUARRYING, the mining of stone. Building stones, such as granite, marble, slate and sandstone, must be extracted in large, unshattered blocks. "Dimension stone" is quarried to assigned dimensions; "rubble stone," in slabs or blocks of irregular sizes.

Quarries are usually open-cut excavations. After the OVERBURDEN is removed, stone is blocked by cutting tools or explosives. The methods will vary greatly with the hardness, structure, cleavage and other physical qualities of the rock. In hard rocks, the separation is usually effected by blasting. In softer rocks, and for dimension stone, or machine cutting, has to be done. Channeling machines are driven by steam, electricity or compressed air.

An important branch of quarrying is that of crushed rock for road building, cement manufacture and other industrial purposes. Here the rock is extracted by drilling and blasting, and then put through crushers. Low cost of operation is the first consideration.

BIBLIOGRAPHY.—C. Le N. Foster, *Ore and Stone Mining*, 1910.

QUART, a measure of capacity, comprising one-fourth of a GALLON in liquid measure and one-eighth of a PECK in dry measure. In the United States, the liquid quart contains 57.75 cu. in.; the dry quart, 67.2 cu. in.

QUARTERING, in mining, a hand method of reducing a sample of ore to a smaller size. The material is shoveled into a cone-shaped pile which is flattened and divided into four equal quarters. Two opposite quarters are rejected, and the operation is repeated, as often as is necessary, with the two remaining quarters. See also SAMPLING.

QUARTERMASTER CORPS, the organization which furnishes clothing, food, equipment and shelter for the men and animals of the ARMY; supplies means of transportation by land and water, including animal,

motor, rail and boat; constructs and maintains buildings and utilities other than fortifications; conducts the promotion and encouragement of civilian production of horses suitable for Army purposes; has charge of national cemeteries in the United States and abroad, post cemeteries and interments, supervises military national parks and monuments; acquires land needed for army purposes, and performs such other duties not otherwise assigned by law as the Secretary of War may prescribe.

This army activity, established June 16, 1775, under the designation of The Military Stores Department, practically dates from the birth of the nation and, during the crucial periods of the Revolutionary, Mexican, Civil, Spanish-American and World Wars, as well as Indian campaigns, its activities have had a most intimate bearing on the achievement of the combatant arms. The Corps' accomplishments have likewise been noteworthy during catastrophes of flood, storm, fire, earthquakes and epidemics, when it has sheltered, fed and clothed the destitute. In times of peace, about 85% of supply expenses of the Army lies with the Quartermaster Corps, while in war times it controls about 50%. The operations of the quartermaster branch of the Army is in close and constant contact with, and has an important relation to, the business, industrial and commercial life of the nation, which fact is mutually helpful to both the Army and the civilian population. J. L. D.

QUARTERMASTER GENERAL, a military officer who is the chief of the quartermaster corps or supply department of the army. He has the rank of a major general. His headquarters are in Washington, D.C. The British army has a similar officer.

QUARTER SQUARES, a device for multiplying one number by another by means of a table devised for this purpose. It is based upon the following algebraic principle:

$$4ab = (a + b)^2 - (a - b)^2$$

$$\text{whence } ab = \frac{(a + b)^2}{4} - \frac{(a - b)^2}{4}$$

That is, the product of two numbers a and b is the difference between a quarter of the square of their sum and a quarter of the square of their difference. Hence, if we have a table of the quarter squares of numbers, we can, by subtraction, find the product of the two numbers. To take a simple illustration, find the product 12×15 by quarter squares.

$$12 + 15 = 27$$

$$15 - 12 = 3$$

By a table of quarter squares

$$\frac{27^2}{4} = 182\frac{1}{4}, \text{ and } \frac{3^2}{4} = 2\frac{1}{4}$$

Then $182\frac{1}{4} - 2\frac{1}{4} = 180$, the product of 12×15 . An elaborate table of quarter squares, by J. Blater, was published in 1888, but the device never attracted wide

attention. For practical purposes LOGARITHMS and CALCULATING MACHINES are more easily used. The device seems to have been first suggested by the Hindus. It was later used by the Arabs.

QUARTILE, in statistics, points in the same sense as PERCENTILES. The first or the lower quartile is the point on a scale of measurement below which are $\frac{1}{4}$ of the individuals of a given series, and above which are $\frac{3}{4}$ of the individuals of the same series. The second quartile is the median, and the third or the upper quartile is the point on the scale of measurement below which are $\frac{3}{4}$, and above which are $\frac{1}{4}$ of the individuals of the given series.

The term quartile is also used somewhat less accurately as representing the range between the point of the same name and the next lower point. Thus a score is said to be in the second quartile when it lies above the first quartile and below the median. *See* STATISTICS.

QUARTZ, an extremely important mineral in nature, occurring in most IGNEOUS and METAMORPHIC rocks, and in many SEDIMENTARY ROCKS, in soils, and forming most SANDS. Another important occurrence is in veins, alone and as the GANGUE of most ORE DEPOSITS. Quartz refers only to the varieties of silica, the dioxide of silicon, which crystallize in the HEXAGONAL SYSTEM. It frequently occurs in amorphous form, like the opal, and rarely is found in other crystal systems.

Pure quartz is water clear and glassy, but impurities usually impart to it some color or tint. The commonest form is milky white. Several colored varieties are valued as semi-precious stones or ornamental material. Of the former may be mentioned amethyst, rose, smoky or cairngorm, yellow or citrine, and the opalescent cat's-eye. Cryptocrystalline, colored forms are CHALCEDONY, carnelian, chrysoprase, agate, onyx, flint, and jasper. Petrified wood is often wood replaced by agate.

Exceptionally clear quartz, known as rock crystal, is cut into vases, balls, statuettes, and beads. When cut to imitate the diamond it is called rhinestone. Rock crystal is a common gem mineral, and is obtained from Japan, Switzerland, Brazil, New York, and Arkansas.

Ordinary sand, composed usually of quartz, is widely used as an abrasive, and in making mortar, cement, bricks, glass, and filters. As sandstone, quartz is found in such abrasives as grindstones and oilstones. Sandstone is ground up to make glass sand. Chert and flint, impure quartz, pebbles are used in ore grinding mills. Diatomaceous earth and tripoli, siliceous remains of organisms, are used as polishing agents and filtering media.

Quartz is widely distributed. *See also* QUARTZITE; ORE DEPOSITS; GEM STONES; SANDSTONE; MINERALOGY; PETROLOGY; DIATOMACEOUS EARTH. S. F. K.

QUARTZITE, a rock formed almost exclusively of QUARTZ, the result of metamorphic action on SANDSTONE. Quartzites differ from sandstone in their great hardness, denseness, and more crystalline character.

Some quartzites are remarkably pure, but others may contain such minerals as feldspar, mica, chlorite, magnetite, hematite, and sometimes calcite.

Quartzites, being very durable, may be used as building stones, but their hardness makes it difficult to work them. Crushed, they are used for railroad ballast and concrete. Especially pure varieties are ground for glass sand. They are found in areas of metamorphosed sediments, as in New England and the Appalachian Mountains. *See also* PETROLOGY; METAMORPHISM.

QUASIMODO, in Victor Hugo's *NOTRE DAME DE PARIS*, a misshapen dwarf who falls in love with, but is spurned by, Esmeralda the gypsy girl. When she is executed he dies of grief.

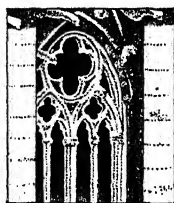
QUATERNARY PERIOD, the second and last subdivision of the CENOZOIC ERA of geological history. It includes the Pleistocene and Recent Epochs, extending down to modern times.

QUATERNIONS, a calculus of vectors, that is, of such quantities as force or velocity which involve both direction and magnitude. The theory was invented by Sir William Rowan Hamilton in 1848. It gave to mathematicians a tool especially adapted to the treatment of rotations and the composition of rotations about various axes, a matter which is cumbersome to handle by the usual methods of ANALYTIC GEOMETRY.

A quaternion is an operator, which, applied to one of two directed line segments or vectors emanating from a common point, transforms it into the other. The operation consists of a stretching, or a compression, and a rotation. Since a given vector, operated upon by a quaternion q_1 , followed by another q_2 , is transformed into a new vector which might have been obtained from the original one by a single operation q_3 , the effect of q_3 is equivalent to that of q_1 , followed by q_2 , and q_3 is called the product of q_2 and q_1 . Unlike ordinary products, q_2q_1 is not equivalent to q_1q_2 .

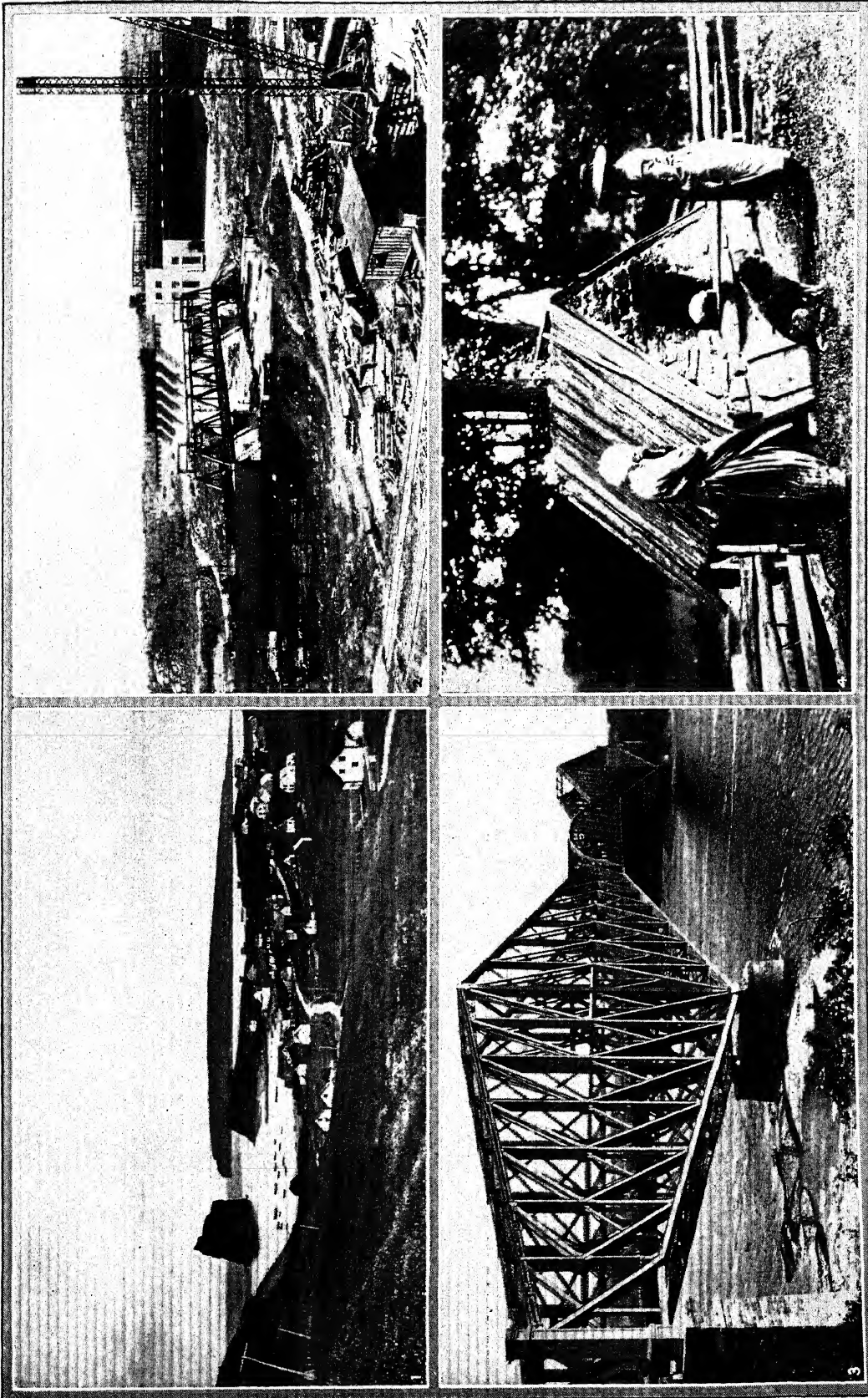
In similar fashion, addition, subtraction, division, and the differentiation of quaternions are defined. A quaternion is seen to be the sum of two component parts,—a *scalar* (pure number) and a *vector*. Upon this basis rests a method of great simplicity and power for the analysis of geometric and physical problems. In spite of this fact, however, the theory has not fulfilled the hopes of its early advocates, being replaced by the later theories of tensor analysis and vector analysis. M. D. D.

QUATREFOIL, a form common in Gothic architecture formed of four convex sided lobes radiating from a center, like a four-leaf clover. The pointed shapes between the lobes are called Cusps. By a similar derivation the forms trefoil, cinquefoil and hexfoil are developed and used. The quatrefoil is one of the commonest forms of geometric tracery, and is frequently enclosed in a circumscribing circle. It is



QUATREFOIL, FROM
NOTRE DAME,
PARIS

QUEBEC

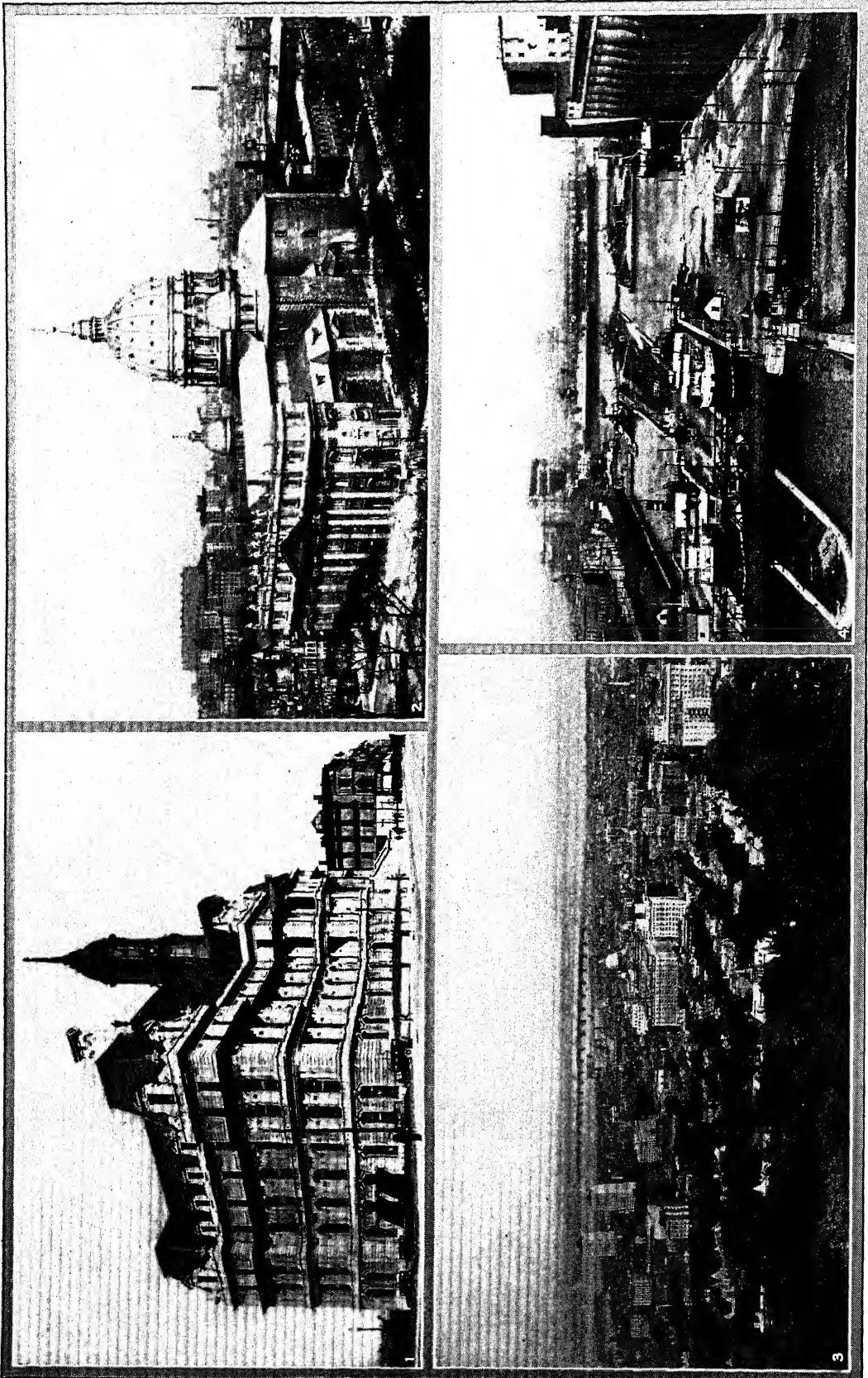


1, 2, 3, COURTESY CANADIAN NATIONAL RAILWAYS

OLD AND NEW IN CANADA'S LARGEST PROVINCE—QUEBEC

1. The tiny fishing village of Percé on the Gaspé Peninsula.
2. Hydroelectric power plant on Lake St. John in northern Quebec.
3. Quebec Bridge spanning the St. Lawrence River 7 mi. above the city of Quebec.
4. An outdoor bake oven. Descendants of the early French Canadian settlers still cling to the life of their fathers.

QUEBEC

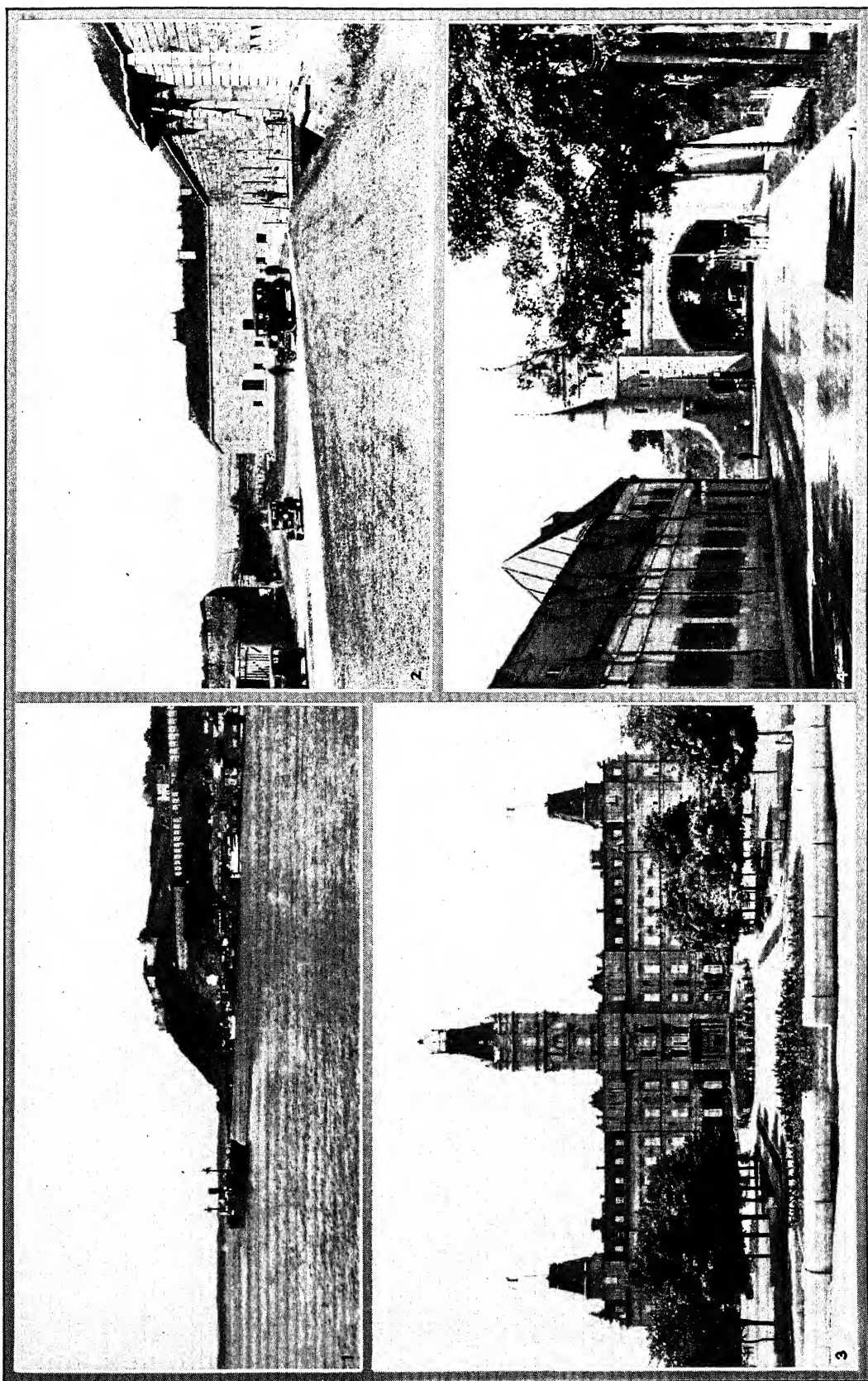


1. COURTESY CANADIAN PACIFIC RAILWAYS; 3, 4, CANADIAN NATIONAL RAILWAYS

MONTREAL, LARGEST CITY OF THE DOMINION OF CANADA

1. The City Hall on Notre Dame Street. 2. St. James' Cathedral.
3. The city from Mount Royal, showing the St. Lawrence River and Victoria Bridge. 4. Section of the harbor.

QUEBEC (CITY)



IN 'THE HISTORIC CITY OF QUEBEC

1. View of the citadel on the summit of Cape Diamond.
2. The citadel, often called the most impregnable fortress on the continent.
3. Parliament Buildings of the province of Quebec.
4. St. Louis Gate leading to the Plains of Abraham where Montcalm met defeat.

also used as a decorative panel form, and in pierced work.

QUAY, MATTHEW STANLEY (1833-1904), American legislator, was born at Dillsburg, Pa., on Sept. 30, 1833. He was graduated from Jefferson College in 1850, studied law, and was admitted to the bar in 1854. He served in the state legislature, 1865-67, was secretary of state for Pennsylvania, 1872-78 and 1879-82, and was made state treasurer in 1885. Elected to the Senate in 1887, he held his seat until 1899, when he was charged with misappropriation of public funds.

On the day of his acquittal he was appointed Senator *ad interim* by the governor, and was elected to the seat in 1901. In Republican politics of Pennsylvania Quay was a power from 1869. He died at Beaver, Pa., on May 28, 1904.

QUAYLE, WILLIAM ALFRED (1860-1925), American bishop, was born at Parkville, Mo., June 25, 1860. He was educated at Baker University, Baldwin City, Kan., and in 1886 was ordained a Methodist Episcopal minister. The same year he joined the faculty of Baker University, in which he became professor of Greek and of which he was president from 1890 to 1894. Subsequently he held pastorates in Kansas City, Indianapolis and Chicago. In 1908 he was consecrated a bishop of the Methodist Episcopal Church. Among Quayle's works are *The Dynamite of God*, 1918, *The Uncommon Common Place*, 1921, and several volumes of poems and essays. He died near Baldwin, Kan., Mar. 9, 1925.

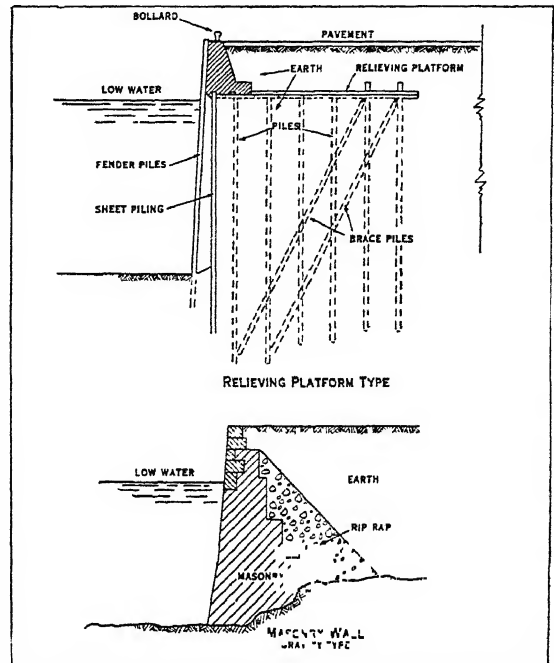
QUAYS, spaces at the shore serving as landing places for vessels and cargoes (*see also* WHARVES). Quay walls serve to retain the earth and to provide convenient landing places. They are constructed in many forms and of various materials to suit a multiplicity of conditions. Various designs include solid masonry walls; stone filled, timber or concrete crib walls; timber and concrete pile platforms or "relieving" platforms with earth or riprap slopes, or with sheet piles of timber; concrete or steel; platforms on CAISSONS or on masonry PIERS; and many other combinations. *See also* WHARVES; BULKHEADS; SEA WALLS.

QUAZVIN. *See* KAZVIN.

QUEBEC, a province of Canada, bordered on the south by the states of Maine, New Hampshire, Vermont, New York, and the provinces of New Brunswick and Ontario; on the east by the Gulf of St. Lawrence and Labrador; on the west by Ontario and Hudson Bay; and on the north by Hudson Strait and Ungava Bay.

Area. Quebec is the largest province in the Dominion of Canada. The older portion of the province comprising 351,873 sq. mi., extends from 57° to 79° E. long. and from 45° to 53° N. lat., and is divided from southwest to northeast by the St. Lawrence River. The addition, under the provisions of the Quebec Boundaries Extension Act of 1912, of the

district of Ungava lying immediately to the north, increased the area of the province by 351,780 sq. mi., making the total 703,653 sq. mi. But this was diminished as a result of the Labrador boundary award, to make a total area estimated at 594,434 sq. mi.



CROSS SECTION OF RELIEVING PLATFORM AND MASONRY WALL TYPE QUAY WALLS

The region north of the SAGUENAY RIVER between Labrador and Hudson Bay is partly unexplored. The lowlands of the St. Lawrence, a fertile plain extending along the river west of the city of QUEBEC, is a thickly settled area. South of the St. LAWRENCE RIVER is the eastern townships region, a district of good farmland. The Notre Dame Mountains in this region have a peak, Mt. Sutton, which is 3,000 ft. high. Gaspé Peninsula, a high forest-clad area, lies to the northeast of the valley of the St. Lawrence. The entire area of the southeastern portion of the province is about 50,000 sq. mi.

Islands. A large number of islands form a part of the province. Montreal Island, 32 mi. long by 11 wide, contains the city of MONTREAL. ANTICOSTI Island, 130 mi. long by 35 to 40 mi. wide, is at the mouth of the St. Lawrence. The Ile Jesus, close to that of Montreal, is 22 mi. long by 6 mi. wide. The Isle of Orleans, 21 mi. long, near the city of Quebec, is a highly fertile area. The Magdalen Islands in the Gulf of St. Lawrence are important for their fisheries.

Rivers and Lakes. The principal rivers are the St. Lawrence, Ottawa, Saguenay, Gatineau, St. Maurice and Hamilton. The largest lakes are MISTASSINI, Melville, St. John, Attikonak, Ashuanipi, Evans and numerous smaller bodies of water. The St. Lawrence River is navigable by large vessels to Montreal and

by means of canals as far as Lake Ottawa. Traffic is closed during the winter. The OTTAWA RIVER drains an area of about 80,000 sq. mi., emptying into the St. Lawrence by four mouths. The Saguenay River flows from the beautiful Lake St. John through steep, rocky banks and over vast rapids. The St. Maurice River, after a 400 mi. journey through forests, joins the St. Lawrence at the city of Three Rivers. The Richelieu River has become important, being aided by a small canal that permits navigation from Montreal to Lake Champlain and thence via the Hudson to New York. During the winter the frozen rivers and lakes are used for the transportation of produce.

Transportation. The headquarters of the Canadian National Railway and the Canadian Pacific Railway are at Montreal, and this city is connected by rail with the chief cities of North America. When the St. Lawrence is not frozen, Montreal and Quebec are connected by steamships with many parts of the world. The Quebec Bridge, near the city of Quebec, connects the north and south sides of the St. Lawrence River.

Climate. Over so great an expanse of territory the climate is very varied, but in the regions of greatest population, the summers are hot and the winters cold. Summer temperatures of 85° and even 95° F. and sub-zero winter temperatures are not uncommon. In consequence of the moderating effect of the Atlantic Ocean and the Great Lakes, temperatures at the city of Quebec average 290 days in the year above freezing point. At Montreal there is usually from 1 to 3 in. of snow cover during a period of four months. Winds passing over the cold Labrador current lower temperatures in the north where Arctic conditions prevail. The annual precipitation of the province averages 40 in.

Agriculture. In the old days the farmer of Quebec seldom varied his system of farming. The system was a makeshift, but a rich soil assured crops of grain, roots and hay. The influx of Loyalists from the United States from about 1774 caused a change, as they brought beef cattle with them when they settled on the lands. The settlements prospered, and later were reinforced by French Canadians from the *seigneuries*. The St. Lawrence lowlands, the eastern townships and the valleys of the rivers flowing into the St. Lawrence are now the principal farming districts. Oats, hay, clover, potatoes, barley, buckwheat, rye, beans and peas are produced on the fertile soil of these districts. Apples, pears and cherries are grown extensively in the eastern townships area. The district around Montreal is noted for its "Fameuse" apples, which have been grown there for over 200 years. Tobacco grows well south of the St. Lawrence, and nearly every Quebec farmer grows a little. On account of the short summers early varieties, black smoking tobaccos of strong flavor, are chiefly grown. The total value of maple sugar and syrup production amounts to about \$3,000,000 annually; this represents about 60% of the total value for Canada.

PRINCIPAL FIELD CROPS, QUEBEC

1930 and Five-Year Average 1925-1929

Crop		Area	Yield	Total	Total
		acres	Per Acre	Yield	Value
			bu	bu	\$
Wheat	1930	58,700	18 0	1,050,000	998,000
Av.	1925-29	61,653	17 1	1,051,400	1,807,600
Oats	1930	1,899,800	26 6	50,635,000	23,798,000
Av.	1925-29	1,813,208	26 8	48,573,200	33,513,200
Barley	1930	156,700	23 5	3,678,000	2,391,000
Av.	1925-29	131,003	23 3	3,058,600	3,230,200
Peas	1930	38,200	14 6	556,000	1,168,000
Av.	1925-29	36,761	15 4	565,800	1,529,600
Beans	1930	24,100	17 3	416,000	1,040,000
Av.	1925-29	14,926	16 6	247,600	766,200
Buckwheat	1930	156,900	23 2	3,635,400	2,654,000
Av.	1925-29	158,741	22 8	3,611,600	3,767,600
Mixed grains	1930	143,700	26 1	3,752,000	2,439,000
Av.	1925-29	119,700	26 4	3,615,600	2,911,600
Potatoes	1930	165,800	81 4	13,491,000	12,816,000
Av.	1925-29	160,682	85 1	13,666,600	21,630,400
Turnips	1930	59,300	182 8	10,840,000	5,420,000
Av.	1925-29	35,287	156 8	5,534,400	3,859,200
			tons	tons	
Hay and clover	1930	4,500,000	1 50	6,771,000	62,635,000
Av.	1925-29	4,217,145	1 50	6,319,400	65,018,000
Fodder corn	1930	70,800	8 47	600,000	3,600,000
Av.	1925-29	86,776	8 66	751,200	3,677,200

Dairying. The annual aggregate value of dairy products is over \$60,000,000. The provincial government has established an effective system of grading and inspecting cheese, butter and condensed milk which has greatly stimulated the industry and improved the products. Large quantities of cheese and butter are shipped to Great Britain.

Livestock. There are many fine herds of French Canadian, Ayrshire, Hereford, Jersey and Guernsey cattle. The French Canadian cattle resemble the Jersey breed; they are hardy, easy to keep, very good in milk and butter fat, but too small for beef. There are still several large flocks of sheep in the province, although the dairy and hog industries are more important.

Fur Industry. There were 5,138 fur farms in the province in 1930. The value of production was about \$2,500,000. The principal furs were silver fox, red fox, white fox, beaver, marten, muskrat, mink and otter.

Forestry. In the north of the province the principal trees are pine, balsam, spruce and fir. In the south, basswood, maple, elm, poplar, oak, and other hardwoods abound. Much timber is cut for pulpwood; this industry has assumed great importance. Several large mills have been built, and during 1927 the production was valued at over \$60,000,000. The lumber industry is still the most important of the province, but the settled portions have been largely denuded of wood, and the provincial government has found it necessary to organize an effective system of fire protection. The forest resources of the province are estimated at 54,000,000,000 board feet saw material and 440,000,000 million cords of pulpwood, posts and ties.

North of Quebec, the Laurentides National Park, 2,640 square miles in area, contains caribou and partridge, and abundant trout in the streams.

Fisheries. The province contains an extensive coast, but the principal fishing activities are inland. The chief varieties of fresh-water fish are the lake herring, whitefish, salmon trout, pike, bass, pickerel and sturgeon. The lobster fisheries are important. Cod, Atlantic salmon, haddock, hake, halibut and flounders are caught inshore.

Water Power. Of the volume of the province's available resources, about 8,000,000 h.p. under conditions of ordinary flow, less than 20% has been developed. The rapidly descending rivers furnish sufficient water power for use in the manufacturing districts. Dams assure an adequate supply in dry seasons. The Gouin Dam on the St. Maurice River creates a storage reservoir 300 sq. mi. in area; and the dam at Mercier, on the Gatineau River, stores a huge volume of water. The rivers of the unsettled parts of the province, although remote, have enormous power-producing possibilities.

Mining. The asbestos industry is important in Quebec. In 1926 the total production was 279,389 tons with a value of \$10,095,487. The quantity of rock raised to furnish this amount of asbestos was 4,483,361 tons. The asbestos of Quebec occurs in veins in serpentine rock of the Devonian Age. These fiber veins vary in width from stringers to about 3 in. After mining, the rock is crushed, dried, ground in rolls, passed through fiberizers which beat the fibrous material so that it separates from the waste rock. The principal asbestos mines are located at Black Lake in the counties of Megantic and Richmond. Copper, zinc and gold are produced in the Rouyn district near the Ontario border. The Portneuf district has the oldest producing zinc mine in eastern Canada. Silver-lead ores are produced for export in the same district. Copper, gold, iron, mica, graphite and molybdenite are all found in commercial quantities in the province. The St. Lawrence valley possesses clays for brickmaking and the raw materials for the manufacture of cement. China clay, valuable as a paper filler, is found in Argenteuil county.

MINERAL PRODUCTION, QUEBEC, 1929

Item	Production	Value \$	Rank Among Provinces
Copper	lb 5,337,169	10,019,601	3
Gold	oz 90,796	1,876,961	3
Zinc	lb. 19,653,440	1,058,731	2
Asbestos	tons 306,055	13,172,581	1
Clay products		3,187,702	2
Cement	bbi. 5,169,408	7,120,374	1
Lime	tons 166,892	1,264,194	2
Sand and gravel	" 6,203,231	1,534,699	2
Stone	" 3,484,471	5,317,859	1
Other products		1,805,283	—
Total all products		46,358,285	3

Manufactures. The importance of the province as a manufacturing region is to a great extent due

to the harnessing of water power resources for commercial purposes. Chief manufactures are pulp and paper, clothing, cigars and cigarettes, ornaments, cutlery, machinery, boots and shoes.

Education. The dual system is in force in the province. In general in the Roman Catholic schools French is spoken, and English in the Protestant. The difficulties of religion and language have been mastered by an arrangement which allows each denomination to have its own committee on the Council of Public Instruction to draft the regulations and courses of instructions for the schools of that denomination. There is complete religious freedom in education. The taxpayers elect the local school board, the local religious majority elects a board of five commissioners, and the local religious minority elects a board of three trustees. There are 14 normal schools for the training of teachers for the various schools. The province has elementary, intermediate and high schools under the Protestant system, and the Roman Catholic system has the primary, complementary classes of schools. There are four universities in the province: McGill University at Montreal, Laval University at Quebec, University of Montreal at Montreal and Bishop's University at Lennoxville. There are several agricultural and technical schools.

Population and Language. The population in 1901 was 1,648,898; in 1911, 2,005,776; in 1921, 2,361,199; in 1931, 2,874,255. The majority of the inhabitants are in the main descendants of the original French settlers, and they retain the French language as their native tongue; the remainder of the population is chiefly of British descent. Use of the dual languages is permitted in Parliament and the law courts.

Chief Cities. Montreal is the largest city and seaport of Canada and Quebec, a picturesque city, is the seat of the provincial government. Other important towns are Hull, on the Ottawa River; Sherbrooke, in the eastern townships district; St. Hyacinthe, a center for the manufacture of knitted goods; Three Rivers, an important lumber port; Grandmere, Shawinigan Falls, Arvida and Chicoutimi.

History. In the course of its history, Quebec has been known as New France or Canada from 1535 to 1763; as the province of Quebec from 1763 to 1790; as Lower Canada from 1791 to 1846; as Canada East from 1846 to 1867; and when, by the union of the four original provinces, the confederation was formed, it again became known as Quebec. The name Quebec was first given to the settlement known as Stradacona, which occupied part of the present site of Quebec, then to a district and finally to a whole province. In 1608 Champlain arrived at Stradacona, an aboriginal village, and named the district Quebec. By the TREATY OF PARIS, 1763, the whole of the region then known as Canada was handed over to England. Quebec was then only thinly populated with French settlements along the lower reaches of the St. Lawrence. By the Constitutional Act of 1791 Canada was divided into two portions: Ontario

or Upper Canada, and Quebec or Lower Canada. Since the confederation was formed in 1867, Quebec enjoys the right perpetually of returning 65 members to the Dominion House of Commons. At each census the number of representatives of the other provinces is adjusted according to the increase or decrease of the population of Quebec. See also CANADA.

QUEBEC, a Canadian city, the capital of the province of Quebec, 180. mi. northeast of Montreal; its position at the confluence of the St. Lawrence and St. Charles rivers at the eastern gateway of the Dominion has given it the name of the "Threshold City."

The lower part of the town, Old Quebec, has beauties and historic interest unequalled in the Dominion. In its upper part Quebec is a modern city in the width of its streets and in the architecture of its public, mercantile and residential buildings. Quebec is the seat of Laval University.

There are several important industries: the city is the center of a large lumber and wheat export trade and footwear is manufactured.

The harbor has a frontage of several miles with berths for the largest vessels, grain elevators, modern cold storage warehouses and graving docks. The port is 400 miles from the Gulf of St. Lawrence and is open eight months of the year. The Quebec Bridge, which spans the St. Lawrence near the city, has rail and motor traffic facilities.

The definite history of Quebec under the rule of white men began in 1608, when Champlain took possession for France, and built a fort in what is now known as Lower Town. In 1629 the place was captured by the British, but after an occupancy of three years it was restored to France, in whose possession it remained until 1759, when it was again captured by the British, under Wolfe. Pop. 1921, 95,193; 1931, 130,594.

QUEBEC, BATTLE OF, Dec. 31, 1775, an engagement of the REVOLUTIONARY WAR which resulted in a British victory. To aid Gen. Montgomery in the invasion of Canada, Gen. Washington sent Col. BENEDICT ARNOLD with 1,200 troops toward Quebec. Starting up the Kennebec and traversing the Maine wilderness in intense cold and with inadequate supplies, the army was reduced to about 500 survivors before it reached the St. Lawrence. After making an ineffectual attack upon Quebec, held by Gen. Carleton with 1,200 regulars, Arnold awaited Montgomery. The two forces joined on Dec. 3 and, on the 31st, made a combined attack during a raging snowstorm. They were repulsed with a loss of 160 men; Montgomery, leading the main attack, was among those killed. The British loss was 20 or less. The defeat at Quebec entailed the failure of the invasion.

QUEBEC, SIEGE OF, an incident of KING WILLIAM'S WAR. Sir William Phips, colonial governor of Massachusetts, assumed command of a maritime expedition against Quebec, capital of New France. On Oct. 16, 1690 his fleet of 34 vessels manned by 2,000 Massachusetts volunteers reached Quebec. Phips pompously demanded that Gov.

Frontenac surrender; upon Frontenac's spirited refusal, he attempted to bombard the strongly fortified city. Finding the attack futile, the fleet returned to Boston in November, after having been ravaged by shipwreck and disease. The failure of the expedition and the demands of the unpaid sailors and soldiers who participated, compelled the colony of Massachusetts, for the first time in its history, to issue paper currency. The capture of Quebec was attempted also during QUEEN ANNE'S WAR, 1711. A British fleet of 11 ships of war and about 60 attendant ships, carrying 12,000 men, commanded by Admiral Sir Hovenden Walker and Gen. John Hill, ran aground on the lower St. Lawrence River, and, due to the incapacity of its commanders, returned without having given battle.

QUEBEC ACT, 1774, an act of Parliament providing a civil government for the Province of Quebec, or Canada. The boundaries of Canada were extended to the Ohio River, in spite of the territorial claims of the chartered colonies. French civil law was established, and in accordance with French custom a centralized system of administration was provided, radically different from the English system of representative institutions. The 13 English colonies, misunderstanding the purpose of the Quebec Act, dubbed it one of the INTOLERABLE ACTS, regarding it as the preliminary move to the withdrawal of their own representative institutions, and holding that the purpose of including the Ohio Valley lands within Canada was to give the Crown a monopoly of the fur trade.

QUEBEC CONVENTION, Oct. 10-28, 1864, a movement preparatory to the confederation of the Canadian provinces. Though continuing in its secret sessions the deliberations of the CHARLOTTETOWN CONVENTION, the Quebec Convention was of larger scope. Its 33 members included 12 from United Canada, seven from New Brunswick, five from Nova Scotia, seven from Prince Edward Island, and two from Newfoundland. Leading delegates were Alexander T. Galt, spokesman for the English minority in Lower Canada, who had introduced the idea of confederation into politics in 1858; Georges E. Cartier, French leader at Upper Canada; William McDougall, exponent of westward expansion, Charles Tupper, prime minister of Nova Scotia; and Samuel L. Tilley of New Brunswick. Each province voted as a unit (United Canada, two votes) in the passage of 72 resolutions, which the delegates promised to induce their respective legislatures to ratify. These resolutions became the basis of the BRITISH NORTH AMERICA ACT, and constituted a detailed treatment of institutions to be established and of issues likely to arise.

QUEBRACHO EXTRACT, the water extract from a South American wood (*Schinopsis Lorentzii*). It furnishes more tannin to the leather industry than any other vegetable source. It is usually heated with sodium bisulphite to decolorize and make easily soluble the difficultly soluble components. It is dis-

tinctive in its universal use and mellowness in tanning, and may be used alone or with other tanning materials. See also TANNINS.

QUECHUA, an important South American Indian tribe and linguistic stock living in Peru and parts of Bolivia and Ecuador. The Quechua now form the majority of both the pure-blooded and mestizo Indian population of the region. At the time of the Spanish Conquest and Quechuas and the AYMARAS were the outstanding members of the INCA empire whose capital was the city of Cuzco. The dialect known as Quechuan was the state language of the Inca and is today the predominant speech of the Indian population of Peru.

QUEDLINBURG, a German city in the Prussian province of Saxony, on the Bode River in the Harz Mountains. With its walls, towers and moat partially intact and the old castle and abbey church towering on high, it is singularly impressive. The castle was the seat of princess-abbesses, the first being Matilda, daughter of King Henry I, who founded the city, and of his wife, Matilda, who founded the abbey at the beginning of the 10th century. Both are buried in the crypt of the abbey church, which contains treasures of great artistic and antiquarian value. Among other buildings of interest is the Klopstock House, where the poet Klopstock was born in 1724. It was a favorite residence of emperors of the Saxon dynasty and was a Hanseatic city until 1477. About 1698, the city and abbey fell to Brandenburg. Gardening and seed culture are important, together with the manufacture of stained glass and paint. Pop. 1925, 27,104.

QUEEN ANNE'S LACE, the name given in the eastern United States to the parent plant (*Daucus Carota*) of the common cultivated carrot. It is very



COURTESY IOWA GEOL. SURV.

QUEEN ANNE'S LACE OR WILD CARROT

abundant throughout Europe and Russian Asia and widely naturalized in the United States, often becoming a pestiferous weed. The plant grows 1 to 3 ft. high bearing finely divided leaves and numerous small usually white flowers, the center one often purple, in a flat, lacelike, many-rayed cluster (compound umbel), 2 to 4 in. broad. The fleshy tap root, unlike that of the cultivated carrot, is woody and possesses a very strong flavor.

QUEEN ANNE'S WAR, 1702-13, a protracted conflict of the Eng-

lish colonies in America with the French and Spanish, incidental to the WAR OF THE SPANISH SUCCESSION in Europe. The first campaign was an unsuccessful expedition from South Carolina against

the Spanish settlement of St. Augustine. The brunt of the war fell upon the frontier towns of New England, harried by war parties of French and Indians. The most gruesome exploits of these raiding parties were the DEERFIELD MASSACRE and the HAVERHILL MASSACRE. Port Royal, Acadia, was taken in 1710 by a British fleet under Col. Nicolson. Encouraged by this victory, Nicolson urged the home government to attempt the conquest of Canada. The feature of the resultant expedition was the SIEGE OF QUEBEC. After this miserable failure, the war dwindled to a series of border skirmishes. The Treaty of Utrecht, 1713, ceded the Hudson Bay region, Newfoundland, and Acadia, henceforth called Nova Scotia, to England, and recognized the IROQUOIS Indians as subjects of Great Britain. The result was a serious blow to French aspirations in North America.

QUEEN CHARLOTTE ISLANDS, a group of islands in the Pacific Ocean off the coast of British Columbia to which they belong politically. Hecate Strait separates them from the mainland. Structurally the islands are part of a submerged mountain range, and the deep, narrow waterways separating the various islands are the submerged cross valleys. The shores are bold and irregular and the surface of the islands rugged and covered with forests. Lumbering, fishing and the mining of bituminous coal are the chief industries. By name the principal islands are Graham, the largest, Moresby, Prevost, Louise, Lyell and Burnaby.

QUEEN MAB, in old Celtic folklore, the midwife of the fairies, but more commonly represented as the Fairy Queen. She is described in Shakespeare's *Romeo and Juliet*, appears in the poems of Ben Jonson, Herrick, Dryden and others, and is the title-character of a well-known poem by Shelley.

QUEEN MAUD'S RANGE. See ANTARCTICA.

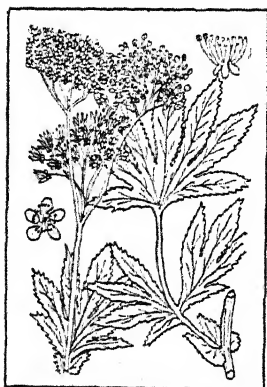
QUEEN OF SHEBA, THE, an opera in four acts by KARL GOLDMARK, libretto by G. H. Mosenthal; première, Vienna, 1875, New York, 1885. It is the best known of Goldmark's several operas. Its German title is *Die Königin von Saba*.

In the court of Solomon, Sulamith, the daughter of the high priest, is betrothed to Assad. At an earlier time he was favored with the love of another beautiful woman whose identity he had never discovered. The Queen of Sheba is about to be received in the palace of Solomon, and Assad is sent to welcome her. He recognizes her as the woman whose memory has enchanted him, but the queen feigns ignorance of his identity. Although Assad is tortured by her beauty, he prepares for his marriage to Sulamith until, in the middle of the ceremony, he hurls the ring to the floor, hurrying to the side of the queen. For a second time she declares that she has never seen him before. For his temerity Assad is held to await the punishment of death. The Queen of Sheba pleads with Solomon not to slay Assad, pretending that a whim prompts her intercession. Banished, Assad staggers forth to the desert, there again to meet the queen. But he has already sacrificed Sulamith for the queen, and he turns

from her in horror and bitterness. Sulamith, seeking escape from a deceitful world, has entered an asylum on the edge of the desert. Coming upon Assad who, overtaken by a sandstorm, lies half buried at the point of death, the deserted and saddened girl pardons her faithless lover as he dies.

QUEEN OF THE MEADOW (*Filipendula Ulmaria*), a tall perennial herb of the rose family called also meadow-sweet, grown as an ornamental. It is native to meadows in Europe and Asia and is naturalized in eastern North America. The branching stems, 3 to 6 ft. high, bear pinnate leaves of several toothed leaflets, white, woolly below, the terminal one very large, and small whitish fragrant flowers in dense clusters.

QUEEN OF THE PRAIRIE (*Filipendula rubra*), a tall perennial herb of the rose family, sometimes called meadow-sweet, frequently grown in gardens. It is a native of moist open grounds especially in prairies, from western Pennsylvania to Michigan and Iowa and southward to Georgia. The smooth erect stem, 4 to 8 ft. high, bears alternate, pinnately divided leaves with a large terminal lobe, and numerous pink flowers in a long feathery panicle.



P. A. RYDBERG, "FLORA OF PRAIRIES AND PLAINS"

QUEEN OF THE PRAIRIE

East River from 59th Street, Manhattan, New York City, to Long Island City. It was opened for traffic in 1909. Its channel span is 1,182 ft., distance of its towers above high water, 333 ft. In 1931, an upper deck was completed and opened for vehicular traffic.

QUEENSLAND, a state of the Commonwealth of AUSTRALIA, occupying the northeast portion of the continent. Its area is 670,500 sq. mi., with a seaboard of 2,250 mi., which has many inlets and bays. The population, 755,972 in 1921, was estimated as 930,871 in 1929. Brisbane is the capital, and other cities are Rockhampton, Townsville, Toowoomba, Ipswich, Bundaberg, Gympie, Cairns and Charters Towers.

The state has large sheep and cattle stations. In 1928 pastoral areas totaled about 200,000,000 acres extending westwards from the Great Dividing Range to the "back blocks." In 1928 the livestock numbered 18,509,201 sheep, 522,490 horses, 5,128,341 cattle and 215,764 pigs. The wool production is valued annually at over \$50,000,000. Coal, copper, tin and gold are mined. The production of coal has shown important gains in recent years; the output of gold, however, has declined.

In 1928 the total area under cultivation was 1,268,475 acres. Sugar cane, maize, wheat, hay and cotton

are the leading crops. Agriculture on the Queensland coastal lands depends on the sugar crop. Under the "White Australia" policy, which called for the deportation of labor from the South Pacific islands, the sugar industry has been protected by a duty on the imported article, and it has been proved that these essentially tropical lands can be worked by white men if the price of their produce is at a high enough level. In 1928 the yield of sugar cane was 3,736,311 tons. The Darling Downs west of Brisbane is a good dairy district.

Queensland's principal exports are dressed meat, wool, hides and skins, sugar, copper, tin and coal. The imports are textiles, footwear, iron and steel, hardware and machinery.

In 1825 a branch penal settlement was made in the Moreton Bay district, then the northern part of New South Wales. This district in 1859 was proclaimed the colony of Queensland.

QUEENSTOWN. See COBH.

QUEENSTOWN HEIGHTS, BATTLE OF, Oct. 13, 1812, an engagement of the WAR of 1812 which resulted in a British victory. Gen. Stephen Van Rensselaer, commanding about 2,600 United States troops and an equal number of United States militia, stationed along the Niagara River, crossed to the Canadian bank to attack a British force of 1,500. The battle centered about Queenstown Heights, beginning as an engagement between the detachment first to land, under Capt. Wool, and a British force under Capt. Dennis, and widening in scope as other Americans landed and other British detachments, stationed at nearby points along the Niagara, hastened to Queenstown. In the day's desperate fighting Gen. Brock, commanding the British, was killed, and Gen. Van Rensselaer and Capt. Wool disabled. The prolonged affray terrified the militia on the American bank; they refused to cross. The ferocity of the Indian allies of the British carried the day. After 90 Americans had been killed and 100 wounded, the remaining force on the Canadian side, about 900, surrendered. The British loss was about 130.

QUEEN'S UNIVERSITY, at Kingston, Ont., Canada, an institution founded in 1841 as a non-sectarian, coeducational college in protest against the denominational control of the Provincial University. It had productive funds in 1931 amounting to \$2,225,000. The library of 136,675 volumes contains a valuable Canadian Historical Section and the Lorne Pierce Collection of Canadiana. In 1931-32 there was a student enrollment of 3,649, and a faculty of 125 headed by J. C. Connell, acting president.

QUENCHING, as applied in metallurgy, is the act of rapidly cooling a metal or alloy from a higher to a lower temperature. The commonly used media are water, brine or oil. A blast of air is sometimes employed. The object is to modify the physical properties which the alloy possesses in the annealed, forged, rolled or cast condition.

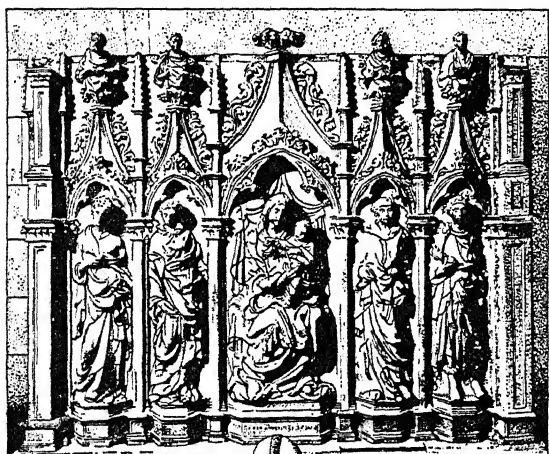
Quenching is chiefly applied to steel although in recent years it has been applied to aluminum alloys,

such as duralumin. Applied to tool steel, the purpose is to increase hardness. Applied to structural steels, it increases tensile strength and elastic limit.

H. E. K. R.

QUENTIN DURWARD, a historical romance by SIR WALTER SCOTT; published 1823. The scene is set in France in the time of Louis XI. While visiting his uncle in France, young Quentin Durward is chosen by the king to deliver Isabelle of Croye, the fair ward of Charles, Duke of Burgundy, to the Bishop of Liège. Quentin and Isabelle are attacked at Liège by a brigand, William de la Marck, who is in league with the king against the duke. The bishop is murdered, but Quentin escapes with Isabelle. Louis, defeated by the duke, then decrees that the bishop's avenger shall be rewarded with the hand of Isabelle—an honor which Quentin finally wins.

QUERCIA, JACOPO DELLA (1369?-1438), Italian sculptor, was born at La Quercia, Italy, the son of a goldsmith from whom he probably learned his trade. Quercia represents the transition between the Middle Ages and the Renaissance in Italy. To him are ascribed the sleeping effigy of the Lady Ilaria del Guinigi on her tomb in the Cathedral at Lucca;



ANTEPENDIUM, OR ALTAR FRONT, BY JACOPO DELLA QUERCIA
A marble relief of the Virgin and four saints in the Church of San Frediano at Lucca, Italy

the Fonte Gaia at Sienna; a relief for the baptistry at Sienna; and, most important of all, the door of the Church of San Petronio at Bologna. His work is noted for its imposing, dramatic qualities, and while it is often lacking in the handling of small details, its excellence as a whole overshadows these minor defects.

QUERCITRON, a name given to the black oak (*Quercus velutina*), a large North American timber tree yielding quercitron, used in dyeing and tanning. The quercitron of commerce is a fine yellow powder produced by grinding the inner bark after the black outer layer has been removed. The orange-colored liquid obtained by boiling quercitron in water contains quercitanic acid and quercitrin. The former is the tanning principle; from the latter is prepared a citron-yellow dye. See also DYE STUFFS; OAK.

QUERÉTARO, a state of Mexico, situated on the great central plateau of the country, with an area of 4,493 sq. mi. It is traversed by the Sierra Gorda Mountains in the north, and slopes to the south to a rich lowland region. It has a mild dry climate, with cool nights in the higher regions. The soil is deep and rich. The principal rivers are the Jalpan, Extoraz, Montezuma and Galindo. Important mercury deposits, onofrite in particular, and some of the finest opals in Mexico are mined here. The chief agricultural products are dates, figs, strawberries, lemons and a very special variety of sweet potato, grown in the temperate zone. The capital is QUERÉTERO, and other cities are Jalpan and Talman. Pop. 1921, 220,231; 1930, 234,386.

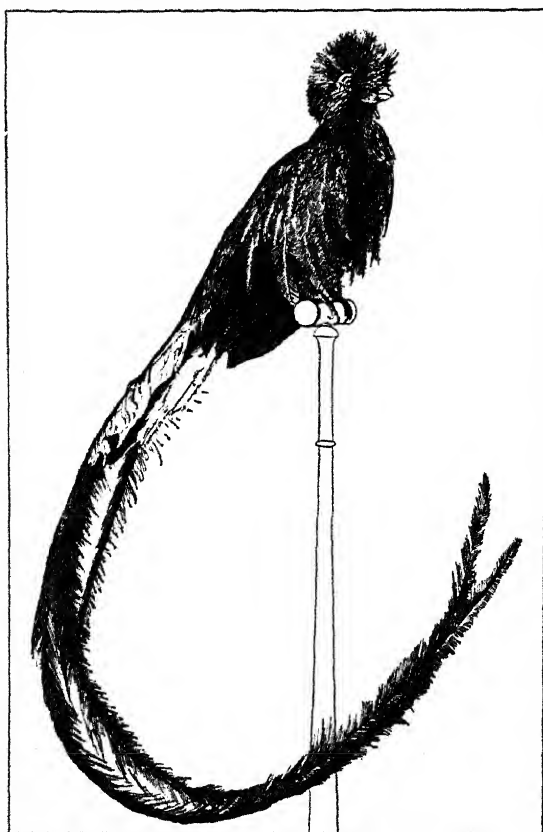
QUERÉTARO, a city of Mexico and capital of the state of the same name, is situated on a plain near the Cerra de Las Campanas, about 167 mi. northwest of Mexico City, at an altitude of 5,957 ft. above sea level. It manufactures flour, leather and tobacco and has perhaps the largest and oldest cotton mills in the country. The water supply is brought in through an aqueduct more than 5 mi. long. Some of the interesting buildings are the Iturbide Theater, the cathedral, built about 1535, the churches of San Augustine, Santa Clara and Santa Rosa. The last was designed by Eduardo de Tresguerras, a celebrated Mexican architect.

Many historical events occurred here. Among the most interesting was an uprising against Spain in 1810, the capture of Maximilian, his trial in the old Iturbide Theater, and his execution just outside the city. In 1848 a Mexican congress met here to ratify the treaty of peace with the United States and here the Mexican constitution of 1917 was adopted. Querétaro was founded in 1440 by Otomie Indians. Pop. 1921, 30,073; 1930, 75,434.

QUESNAY, FRANÇOIS (1694-1774), was born at Méré near Paris, June 14, 1694. He studied surgery and became, in 1752, first consulting physician to the king, but occupied himself with the study of philosophy and economics. With de Gournay, he was one of those who formed the economic school of the Physiocrats. He is mainly remembered for his *Tableau Économique*, in which he analyzes the deficiencies of the French agriculture and expounds his economic doctrine. He died at Paris, Dec. 16, 1774.

QUEVEDO Y VILLEGAS, FRANCISCO GOMEZ DE (1580-1645), Spanish satirist, was baptized at Madrid, Sept. 15, 1580. By his 21st year he had acquired a remarkable knowledge of languages, law and theology. Short-sighted, and with clubbed feet, Quevedo was an expert swordsman and excessively quarrelsome. After holding important diplomatic and government posts, he attacked Olivares, the royal favorite, who promptly imprisoned him in a damp dungeon, whence he emerged, on the minister's fall, in shattered health, to die at Balbuena, Sept. 8, 1645. His picaresque novel, *Pablo de Segovia*, is a witty and sparkling masterpiece, worthy of the most gifted and honest Spaniard of his time.

QUEZAL (*Pharomacrus mocinno*), an exceedingly beautiful bird of the trogon family native to Central America. The male, about 2 ft. long with a handsome crest, has wing coverts lengthened into drooping plumes and the upper tail coverts are also greatly elongated. Its upperparts and throat are brilliant metallic green, the underparts vivid scarlet, and the tail black and white. The female is duller in color and lacks the lengthened wing and tail feathers. Some-



COURTESY AMER. MUS. OF NATL. HISTORY

QUEZAL

what solitary in habit, the quezal dwells in dense forests, usually frequenting the tops of the highest trees and feeding largely on fruit, which it secures mostly on the wing. It nests in hollow trees, laying greenish-blue eggs. Before the Spanish conquest the quezal was highly venerated, its very decorative feathers being worn only by the native chiefs. Recently its numbers have been greatly reduced because of the demand for the plumes as hat ornaments. The quezal is the national emblem of Guatemala.

QUEZALTENANGO, the capital of the department of Quezaltenango, Guatemala, situated on the River Sigüila; nearby is the volcanic peak, Santa Maria. It is a large town, for Central America, with a great plaza, a great cathedral, and an imposing theater. But all the houses have suffered so much from earthquakes that cracks seam their walls. Most of the population is Indian. Here is located the most powerful bank in the republic, to a large extent the product

of Indian thrift. The town was partly wrecked by an earthquake in Apr. 1902 and an eruption of Santa Maria in October of the same year. Pop. 1928, 30,125.

QUEZON, MANUEL L. (1878-), Philippine public official, and independence leader, was born in Baler, Province of Tayabas, Philippines, Aug. 19, 1878. He attended the College of San Juan de Letran, studied law at the University of Santo Tomas and was admitted to practice in 1903. He served as major in the Philippine insurrection under Aguinaldo and with the establishment of American rule became prosecuting attorney for the province of Mindoro and later of Tayabas. He was elected provincial governor in 1906. The next year he resigned, was elected member of the first Philippine Assembly, and joined the Nacionalista Party. He became Resident Commissioner to the United States in 1909 and held this post until 1916. The United States Congress in 1916 approved the Philippine Autonomy Act, for which Quezon was in a great measure responsible, granting increased autonomous powers to the Filipino people and providing for a Philippine Legislature consisting of a Philippine Senate and a House of Representatives. Quezon resigned as Resident Commissioner, was elected to the Philippine Senate and has been a member and President of this body since 1916. He has constantly demanded independence for the Islands.

QUICK, JOHN HERBERT (1861-1925), American writer, was born in Grundy County, Iowa, Oct. 23, 1861. From 1882 to 1890 he taught school and studied law. Admitted to the bar in 1889, he practiced in Sioux City until 1909, when he became associate editor of *La Follette's Weekly* and, later, editor of *Farm and Fireside*. His fiction includes *Double Trouble*, *The Brown Mouse* and *Vandemark's Folly*. Quick published a book, *American Inland Waterways*, and after his death his autobiography, *One Man's Life*, was published. He died at Columbia, Mo., May 10, 1925.

QUICK, ROBERT HENRY (1831-91), English educator, was born in London, Sept. 20, 1831. He graduated from Trinity College, Cambridge, in 1854, and was ordained the following year. After 12 years of teaching in English grammar schools he was given in 1870 an assistant mastership at Harrow where he remained four years. In 1881 at Cambridge he gave the first series of lectures on the history of education. He wrote numerous pamphlets on methods of teaching and the training of teachers; but the work for which he is best known is *Essays on Educational Reformers*. In 1887 Quick retired to Redhill and died at Cambridge, May 9, 1891.

QUICK HARDENING CEMENT. See CEMENT.

QUICKSAND, unstable, treacherous sands which when wet become "soupy," quickly swallowing up any heavy body entrusted to their surface. Ordinary sand is composed of more or less harsh, angular particles, which pack solidly when damp, making sure footing even for horses, or even a firm runway for motor-cars. Quicksand, which is especially common

in glaciated regions, is made up of small, smooth, rounded grains which slip on each other when moistened or when partly water borne, so that the loose mass is rather like a fluid. Quicksands may be met with on flat seashores, in stream beds of arid regions, or at the mouth of streams. They sometimes embarrass mining or engineering operations, necessitating the use of caissons as for underwater excavation. Men and animals, and, it is said, railway trains, have been engulfed in quicksands.

QUICKSILVER. See MERCURY.

QUIDS, 1805-11, followers of JOHN RANDOLPH attached to extreme STRICT CONSTRUCTIONIST views, a faction of the DEMOCRATIC-REPUBLICAN PARTY which separated itself from the administration and favored Monroe as successor to Jefferson. They were called Quids after Randolph's declaration that he belonged to the "*tertium quid*, that third something, which had no name, but was really an anti-Madison movement."

QUIETISM, the name given to a form of pantheistic Christian mysticism or, as some hold, of pseudomysticism, which has found expression in the writings of certain Roman Catholics, but which has been condemned by the Roman Catholic Church. Quietists have inculcated the doctrine that the soul in all its relations with God should be entirely passive; that in a state of mental and physical inaction the highest religious experiences are found. The teaching has been opposed as being "a sort of psychical annihilation." It was advocated from the 13th to the 15th centuries by the Brethren and Sisters of the Free Spirit, and also by some of the Beguines. Michael de Molinos in the 17th century endeavored to give the doctrine some theological basis, especially in his work, the *Dux spiritualis* (Rome, 1675), but the attempt was condemned in 1687 by Pope Innocent XI, who was in a manner confirmed by the condemnation promulgated by the Council of Vienne, 1311-12. Without adopting the radical view of the early Quietists, who held that anything active on man's part was an offence to God, a Semi-Quietism was preached in the 17th and 18th centuries by Fénelon and Madame Guyon.

QUILEUTE, a North American Indian tribe and, except for the Hoh, the only representative extant of the Chimakuan linguistic stock. In 1931 a few more than 200 lived on the Quileute Reservation in Clallam Co., Wash. Never numerous, they were warlike and self-sufficient, resisting conquest by near-by tribes. The Quileute are best known as successful sealers and whalers, although salmon-fishing was also an important industry. Besides salmon and other products of the sea, roots and berries were the mainstay of their diet. Culturally their affiliations appear to have been with the peoples of Vancouver Island.

QUILL, the hollow, tubular feather of a bird. In certain larger feathers, usually from the wings and tail, the part nearest the body is hollow and is called the barrel, calamus or quill. The quills of commerce, made usually from the feathers of geese, were first properly cleaned of any oily matter within and then

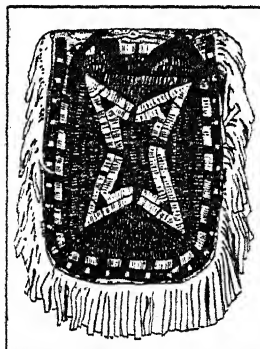
dried to be used as pens. For drawing or fine writing, the quills of crows were especially esteemed. Those of swans and turkeys were also used. Nowadays quill pens are largely decorative. A certain sort of toothpick is made of quill. The hard, protective shell of large quills has also served as a safe receptacle, the Inca Indians using eagle quills to pack gold dust, so that a quillful became an accepted measure in trading. Porcupines are said to have quills, though not like those of birds, and the term is also used in connection with the squid. It has also been applied in other connections, a quill of cinnamon being a roll of dried bark from the tree; a series of cylindrical ruffled pleats is called quilling. In music, a quill is an object used to strike ancient delicate stringed instruments. G. E. F.

QUILLER-COUCH, SIR ARTHUR THOMAS (1863-), British author and man of letters, was born in Cornwall, Nov. 21, 1863. He is best known for his charming stories and sketches of life in that region. A few of his many books are *The Delectable Duchy*, *The Ship of Stars* and *The Shining Ferry*. After R. L. Stevenson's death he completed that author's unfinished novel, *St. Ives*. Volumes of verse and critical essays and several valuable anthologies are among his works. Quiller-Couch was knighted in 1910 and in 1912 was appointed King Edward VII professor of English literature in Cambridge University. He has sometimes used the pen name "Q."

QUILLWORK, a North American Indian craft of decorating jackets, moccasins, knife-cases and other articles with porcupine quills. This was the great Indian method of decoration before glass beads were introduced by Europeans, and was practised in practically all sections where the porcupine was found, from Canada and Alaska south to the plains of the West and the woodlands of the East. Some of the most exquisite examples have come from regions where the porcupine is not native and the Indians obtained the quills by bartering. The quills were flattened out and used either in their natural shades or were dyed. Bird quills were extensively used in Alaska.

QUILLWORT, the common name for a genus (*Isöetes*) of small grasslike, mostly aquatic plants allied to the club mosses and ferns. There are about 60 species, natives of temperate and tropical regions, some 20 of which occur in the United States. The plant body consists of a very short stem producing numerous roots below and sending up a tuft of awl-shaped or quill-like leaves which bear spore-cases (sporangies) in their axils.

QUIMPER, a picturesque old town in southern Brittany, capital of the department of the Finistère.



COURTESY AMER. MUS. OF NATL. HISTORY

QUILL EMBROIDERY OF THE PLAINS INDIANS

Its cathedral, begun in 1239 and completed, after interruptions, in 1515, is a beautiful example of Breton Gothic architecture. The façade is marked by its two tall 15th century towers, and both the west front and the south portal show fine details of FLAMBOYANT Gothic. The curve of the cathedral's axis forms a conspicuous feature of the interior. The church contains much beautiful 15th century glass, and among a number of interesting statues, a 15th century figure of St. John, in alabaster. Quimper, formerly the capital of Cornouaille, has preserved much of its medieval aspect and is a favorite center for travelers. The famous peasant pottery of Quimper remains its chief industry. Pop. 1931, 18,297.

QUINAULT, a North American Indian tribe, a sub-group of the Chehalis, belonging to the Salishan linguistic stock. They lived on the Quinault River, Washington, as well as on the coast between the Quileute and Quaitso on the north and the Chehalis on the south. Several hundred now live on the Quinault Reservation in Washington.

QUINCE, a small tree (*Pyrus Cydonia*) of the ROSE FAMILY. Improved varieties are eaten raw in Persia but in northern climates they are used only for marmalade or jelly or for flavoring cooked fruits. In America it plays an even more minor part than in Europe, mainly because it is subject to attacks of pear blight and apple borers. The former is easily kept in check by cutting and burning the affected twigs and sterilizing the wounds with mercuric chloride solution; the latter by keeping the bases of the trunks clear of weeds so the borers may be destroyed by enemies. Such as survive may be killed by poking flexible wires into their burrows.

In home grounds, although usually relegated to odd corners, the quince deserves a place as an ornamental. Its large flesh-tinted flowers which appear in late spring and its golden, globular fruits in early autumn give it a double value. As an orchard fruit to supply city markets, it is grown to some extent in New York and adjacent states on heavy loams, well-drained but well supplied with moisture. Clean cultivation is essential.

M. G. K.

QUINCY, JOSIAH (1744-75), American lawyer and colonial leader, was born in Boston, Feb. 23, 1744. He graduated from Harvard in 1763, received his master's degree in 1766, and took up the practice of law. During his college days he distinguished himself as an orator, and in the period leading to the Revolution was one of the first to advocate separation from Great Britain. He wrote many political articles for the *Boston Gazette* and other publications, but after the Boston massacre he and John Adams defended and obtained the acquittal of the British soldiers involved. Quincy visited England in the fall of 1774 and died at sea on the return voyage, Apr. 12, 1775. His son, Josiah Quincy (1772-1864), in early life a lawyer, member of Congress, and mayor of Boston, was President of Harvard 1829-45.

QUINCY, a city of western central Illinois, the county seat of Adams Co., situated on the Mississippi

River, 95 mi. west of Springfield. There are bridge and ferry connections with West Quincy, Mo. Transportation facilities include the Burlington and the Wabash railroads. The chief local manufactures are stoves, elevators, air compressors, metal wheels, dyes, pumps and store fixtures. In 1929 the factory output amounted approximately to \$18,000,000; the retail trade reached the total of \$21,683,484. Quincy is the seat of a Catholic College, Chaddock Military School for Boys, the Gem City Business College and Illinois State Soldiers' and Sailors' Home. Its extensive parklands include Indian Mounds Park. Quincy was the scene of a Lincoln-Douglas debate. A small settlement, begun in 1821, it was made the county seat and named Quincy the day John Quincy Adams became President, in 1825. The city charter dates from 1839. Pop. 1920, 35,978; 1930, 39,241.

QUINCY, a city of Norfolk Co., eastern Massachusetts, situated on Massachusetts Bay, separated from Boston on the north by the Neponset River and bounded on the south by the Fore River. Transportation facilities include the New Haven Railroad, bus lines, the Eastern Massachusetts Street Railway and the Dennison Airport. Quincy's chief industrial products are granite, ships and machinery. The total value of manufactured products in 1929 was \$27,150,742. In 1929 the retail business amounted to \$32,794,412. The farm houses where John Adams and John Quincy Adams were born are still standing in the city. Other buildings of interest are the Dorothy Q. House and the home of Presidents John Adams and John Quincy Adams.

When Quincy was first settled, in 1625, it was known as Mt. Wollaston. In the same year Thomas Morton obtained control of the town and renamed it Merrymount. But Morton's encouragement of Maypole dancing and other festivities offended the Puritans, who sent him back to England. Merrymount or Mt. Wollaston was a part of Boston till 1640. Thereafter the settlement was part of Braintree until 1792, when it was incorporated as a town and named for John Quincy. In 1888 Quincy was incorporated as a city. Pop. 1920, 47,876; 1930, 71,983.

QUININE, a white microcrystalline powder (formula $C_{20}H_{24}O_2N_2 \cdot 3H_2O$), having an exceedingly bitter taste, obtained from the bark of various species of *CINCHONA*. Quinine is a protoplasm poison affecting protozoa more than bacteria; it, therefore, finds wide use as a specific against malaria; it also reduces fever and is given as a bitter for improvement of digestion and nutrition. Solution of quinine and urea hydrochloride is sometimes employed as a local anesthetic. Quinine is generally used in the form of its salts, such as quinine sulphate or quinine hydrochloride. Large doses of quinine or its salts may cause deleterious symptoms; they are contra-indicated in diseases of the ear.

Another alkaloid of cinchona is *quinidine*, which is used for arrhythmia of the heart. Other alkaloids derived from cinchona include *cinchonine* and *cinchonidine*.

P. N. L.

QUININE BUSH (*Garrya Fremontii*), an evergreen shrub of the silk-tassel family called also bear brush and feverbrush. It is found on dry mountain slopes in Oregon and California, forming a part of the chaparral. The shrub grows from 5 to 10 ft. high bearing four-angled branchlets, smooth, oblong, leathery leaves, small flowers in slender silky catkins and a black berry-like fruit. The bitter leaves containing the alkaloid garryine, are sometimes used as a tonic and anti-periodic, like quinine.

QUINOA, a South American species of goosefoot (*Chenopodium Quinoa*) found from Columbia to Peru and Chile where it is extensively cultivated as a food plant. It is a stout annual herb somewhat resembling in appearance the common lamb's-quarters to which it is closely allied. The white or reddish seeds, which the plant produces in great abundance, form, when ground into meal, a staple food for the native peoples of the high Andean plateau. The leaves and young shoots are boiled as a potherb like spinach. At the time of the Spanish Conquest quinoa was very widely cultivated.

QUINOLINE, a colorless, oily liquid, C_9H_7N , found in coal tar and bone oil, with other heterocyclic compounds. Its boiling point is $237.7^\circ C$. Its structure has the same relation to naphthalene as pyridine has to benzene. The best method of preparation is Skraup's synthesis: Aniline is heated with glycerol and sulphuric acid in presence of nitrobenzene or arsenic acid as oxidizing agents. Analogs of aniline give substituted quinolines. It is a tertiary base and forms quinolinium salts. Quinoline and some of its derivatives are used as antefebiles, solvents and antiseptics. Quinoline is one of the decomposition products of quinine.

QUINONES, form a class of AROMATIC COMPOUNDS in organic chemistry which are derived from the benzene, naphthalene, and anthracene series of hydrocarbons, and which contain two of the charac-

teristic ketone groups $\diagup \text{C}=\text{O}$. Benzoquinone, also

plainly called quinone, is the simplest and has the formula $C_6H_4O_2$, and can exist in two isomers. They may be prepared by the oxidation of aniline with dichromates or by direct union of benzene and oxygen in the presence of vanadium pentoxide as a catalyst. The quinones are important intermediate substances in the synthetic dye industry, especially anthraquinone, from which the valuable dye alizarin is made. Theoretical interest is attached to them because they seem to afford a clue as to the nature of color in organic substances.

QUINSY. See TONSILLITIS.

QUINTANA ROO, a territory of the republic of Mexico, situated on the peninsula of Yucatán, with an area of about 19,270 sq. mi. It has a long coast line, broken by many small bays, and is dotted with islands. The surface is low and flat, and the soil calcareous. The climate is hot and dry. Several lakes are found in this region, the most important being Lake Bacalar

in the southern part and Lake Talcoch in the north. Quintana Roo is separated from British Honduras in Central America by the Hondo River, the only river of importance in the territory. The capital is Payo Obispo, and other towns are Chobo, Galiban, and Tepich. Pop. 1921, 10,966; 1930, 12,150.

QUINTESENCE, the fifth or immaterial element, the others being earth, air, fire and water. The other four elements were recognized by the early Greeks; the quintessence is most important in connection with scholastic thought.

QUINTILIAN (c. 35-c. 97 A.D.), Roman rhetorician, whose full name was Marcus Fabius Quintilianus, was born at Calagurris, Spain, about 35 A.D. He received an excellent education in oratory at Rome, after which he retired to Spain, but returned to Rome in the retinue of Galba in 68 A.D. There he first practiced as an advocate, and subsequently became an instructor in rhetoric, gaining much renown. Among his many pupils was PLINY THE YOUNGER. Under the endowment of Vespasian, Quintilian received a fixed salary from the imperial treasury. After 20 years of public teaching, he retired into private life to devote himself to the composition of the *Institutio Oratoria*. Some time later, Domitian entrusted him with the education of two grand-nephews, and as a reward for his services, Quintilian received the titular rank of Consul. He died about 97.

Quintilian's most important work, the *Institutio Oratoria*, still extant in 12 books, was written in 2 years, but was continually revised by him until its publication, about 95 A.D. It embraces a complete course in rhetoric, providing a system of instruction for the orator from the cradle to the threshold of a public career. Quintilian believed that high moral character was as essential to the perfect orator as skill in eloquence, and consequently the work contains abundant advice on ethical training. The 10th book is notable for its criticisms on various Greek and Latin authors. Throughout, Quintilian uses CICERO as his model and main authority, imitating the latter's style with admirable skill. Also extant under his name are 164 *Declamationes*, or school exercises, though these are probably not his.

QUIRINUS, in Roman mythology, was identified with MARS in his rôle of protector of the State or god of defense. Later the name was applied to ROMULUS and the festival of Quirinus, the Quirinalia, was celebrated on Feb. 17, the day on which Romulus was supposed to have been taken up to heaven.

QUIRITES, the original designation of the Roman people which was preserved in legal formulae and official terminology.

QUITO, the capital of Ecuador, about 165 mi. north of GUAYAQUIL. It is situated on the Andes at a height of 9,348 ft., has a world-wide reputation as the city on the equator and is said to be the oldest city in South America.

Remote and inaccessible as it has been until the railway united it with the outer world in the early

20th century, Quito still conserves its character of a mountain capital surrounded by lofty snowclad volcanoes. Around the Quito valley are 20 noble volcanic summits whose variety of form is remarkable, from the truncated to the perfect cone, from jagged and sunken crests to smooth, snow-covered gleaming domes, among them the beautiful, if dreaded, *COROPAXI*.

Quito produces various articles such as textiles and prepared foods, but a large part of the population provides for many of its own needs. There is a tendency among all the Andean people to preserve their interesting home crafts and cottage industries, although they are menaced by the cheapness of imported foreign products.

Climatically the region enjoys an eternal spring; the days are warm and balmy and the nights are cool, the mean temperature being about 60° F. The historical interest of Quito lies in the fact that it was the ancient center of the Shiri Empire formed by the mysterious Caras and the Quitus, whose dynasty fell before the Incas under Huayna Capac, who in turn gave way to the Spaniards. Estimated pop. 1930, 120,000.

QUIXOTE PLANT (*Yucca Whipplei*), a stemless species of *Yucca*, called also Spanish bayonet. It is found in the mountains of southern California, chiefly in the chaparral belt. The plant bears at the surface of the ground a rosette of narrow leaves, 1 to 2 ft. long. From this, in May or June, rises a stout flowering stem, 8 to 14 ft. high, bearing a huge panicle, sometimes 6 ft. long, of showy creamy white flowers.

QUM. See *KUM*.

QUOITS, a game probably derived from the *Discus Throwing* of the Greeks. It enjoys almost universal favor, due to the simplicity of the equipment required and to the fact that it is an outdoors pastime. At a distance of from 18 to 24 yards apart, two stakes, or hobs, are driven into the ground. The quoit is an iron ring, rounded on one side and flat on the reverse, which averages about 8½ inches in diameter and 9 pounds in weight. The object is to throw the quoits

over the hob, or to pitch the quoit as near the hob as possible. In most countries where the game is played under formal rules as in the United States, Canada, England, Scotland and France, a quoit is foul which lands on its back, as are quoits which land more than 4½ feet from the stake. The player throws his quoits, two or more, before his opponent begins to play. Games may be played with any number of players for any number of points. The scoring differs in various countries; but the most conventional values are as follows: a ringer, or a quoit which surrounds the hob, 2; a player's quoit closer to the hob than his opponent's, 1, the distance being measured from the pin to the nearest point of the quoit. A quoit championship match is held annually in the United States in contest for the Bell Medal, donated in 1868 by David Bell of Buffalo, N.Y.

QUORATEAN or *KAROK*, a North American Indian linguistic stock, one of the families comprising the *HOKAN*. They lived in northwestern California on the Klamath River, from Redcap Creek to Indian Creek.

QUO VADIS? ("Whither Goest Thou?"), a historical novel by HENRY SIENKIEWICZ; published 1896. It presents a comprehensive, vivid picture of Nero's Rome and the early Christians. Lygia, refusing to yield to the pagan Vinicius, is denounced as a Christian and condemned to die in the arena. She is barely saved from a horrible death by her attendant, Ursus, and later marries Vinicius who, in remorse, has meanwhile been converted. The mad, luxury-loving Nero, Petronius Arbiter, the artistic sensualist, the Apostles Peter and Paul, and a host of lesser personages move in and out of this exciting narrative.

QUO WARRANTO, a writ requiring one claiming or usurping an office, franchise or liberty to show by what authority he holds the office, or exercises a franchise or liberty, thus determining his rights. At present in England, and in most of the states of the United States, an information in the nature of quo warranto has replaced this writ, and is used to determine claims to public offices, offices in corporations, and to franchises.

R

RA or **RE**, in Egyptian religion, the sun god, sprang into life from the ocean. He brought order out of chaos, and ruled the heavens. The children of Ra were Osiris, Isis, Ser and Nephthys. Ra was supposed to sail through the sky in a ship by day and to return through the lower world at night. He wearied of struggling with the world and retired to heaven where he rested on the back of a cow. Ra is represented with the head of a hawk, upon which is a solar disk in the coil of a serpent, and with a scepter in his hand.

RAAB, a city of Hungary. See **Gyor**.

RABAT, Africa, a garrisoned city and seaport of Morocco in the French protectorate. It is situated on the Atlantic coast at the mouth of the Bu-Regreg, 130 mi. south of Cape Spartel. The inhabitants manufacture carpets, morocco leather, cloth and pottery. In spite of the difficulty in gaining access to the port there is a fairly large trade, both import and export. Among the points of interest are a lofty minaret of an old Hassan mosque and the necropolis of Chella. Pop. 1931, 53,006.

RABBENU TAM. See **TAM**, **JACOB BEN MEIR**.

RABBI (Hebrew, *rab*, meaning teacher), the title given to the teachers and to the heads of the Jewish academies in the days of the Mishna and Talmud, 100-500, then to learned men and teachers, and subsequently to the leaders or spiritual heads of Jewish congregations in the Middle Ages, up to modern times. The term was unknown in Biblical days, as was the office or function of the rabbi. It is derived from the Hebrew adjective *rab*, meaning great, distinguished, which in post-Biblical Hebrew acquired the added significance of a noun or title meaning master, in contrast with slave or pupil. While the priests of the First Temple were in existence and functioning, there were no rabbis. The term rabbi first came into vogue after the destruction of the Second Temple, in 70 A.D., for the rabbis from that time forth carried on the work both of the priests and of the prophets. The term rabbi was probably introduced by Johanan ben Zakkar's disciples, who were called master by their adherents.

In the Mishnaic and Talmudic periods and in the Middle Ages, up to about the middle of the 14th century, the rabbis served without pay, and earned their living through the practice of some trade or profession. Certain of the rabbis of the Mishna and Talmud were shoemakers; others were carpenters, blacksmiths, etc. In later days many of them practiced medicine. After the middle of the 14th century the rabbi usually received a fixed salary, no longer practicing a trade or profession, and secured his authorization as rabbi either from an academy (Yeshiva) or from his private teacher.

The early medieval rabbis were not the heads of congregations, in our modern sense of the term, in which rabbi is equivalent to the term pastor or minister. They were concerned with the conduct of the schoolhouse or academy, and with juridical decisions. They had little or no contact either with communal matters or with the members of the congregation, and preached publicly very seldom. Furthermore, their training was purely rabbinical, not secular, and was devoted entirely to Hebrew and rabbinical subjects. As the rabbi's juridical duties decreased, his personal contacts with the members of the congregation increased, until to-day the rabbi is the synagogal or temple head, a man of broad general culture and academic training, preaching regularly in the pulpit, officiating at all public and private Jewish functions, such as weddings, funerals and unveilings of monuments and tombstones, and generally acting as the representative of the congregation in all public, religious and social matters. In all these respects he approximates the functions and the office of the priest of the Catholic Church and of the clergyman or minister of the Protestant denominations.

A. SH.

RABBI BEN EZRA, the title of a lyric poem by **ROBERT BROWNING**; published 1864. Confuting the pessimism of the *Rubaiyat of Omar Khayyam*, this poem gives the author's conception of the true joys of growing old.

RABBIT, a rodent-like mammal found all over Europe and in the British Isles. Introduced into Australia for game, it has become a dangerous pest. Of the several species native to North America, the most common is the cotton-tail (*Sylvilagus floridanus*), found from coast to coast south of Canada. The Pacific coast brush rabbits and the southern swamp rabbits are closely related to the cotton-tail.

Rabbits are smaller than hares and have shorter ears, shorter legs and smaller feet. The short tail is snow-white underneath. When alarmed, the animal shows this white puff or "cottontail." The coat is brownish gray, the underparts white, the throat buff and the ears usually bordered with black.

In spite of their defencelessness and numerous enemies, wild rabbits survive close to civilization. They are very prolific, and the young, born naked, appear in several broods each year. Four is the average litter, and young of the first brood breed during the same year. Rabbits are fond of underbrush and nest in burrows for protection from foxes, owls and other enemies. They eat almost any green vegetation.

Rabbit and hare fur is of great commercial importance, 100,000,000 skins being used annually in the United States. Good rabbit skins are more used for fur, while hare and inferior rabbit skins are used for

felt. Rabbit fur is sold under such trade names as lapin, sealine, electric seal and leopardine. Millions of dollars worth of rabbit meat is sold each year, in 1930, \$2,000,000 worth was marketed in Los Angeles alone.

A. R. F.

RABELAIS, FRANÇOIS (c. 1490-1553), French author, was born at Chinon in Touraine, about 1490. He was from an early age destined for the ecclesiastical profession, and after entering a monastery of the Franciscan Cordeliers was ordained priest in 1511. He threw himself ardently into the classical studies of the Renaissance, evincing special enthusiasm for the Greek. It was indeed from such Greek writers as ARISTOPHANES and LUCIAN that Rabelais drew the inspiration for the great work which was to make him famous. He also owed much to contemporary French and Italian sources, such as the *Morgante Maggiore* of Pulci in Italian. Nor did Rabelais confine himself to literature. He studied medicine at Montpellier in 1530, obtaining his degree in the astonishingly short period of one year, and in 1532 he was lecturing in Lyons on medicine and anatomy. It was at this period, probably amidst the brilliant society of Lyons, that he wrote his celebrated works *Pantagruel*, first published in 1533, and *Gargantua*, 1535, with continuation in three separate books all published before his death. (See GARGANTUA AND PANTAGRUEL.) These unquestioned works of genius hold an anomalous position in literature, their greatness in popular estimation being obscured to some extent by their grossness. Nevertheless their position as original works of fiction and consummate examples of social satire, and their pervasive influence on subsequent literary history are now well established. As an astounding though distorted mirror of the 16th century they serve to link Rabelais with MOLIÈRE and VOLTAIRE as supreme examples of the Gallic gift for wit and satire. Rabelais died on or about Apr. 9, 1553, probably at Turin, Italy. See also FRENCH LITERATURE.

BIBLIOGRAPHY.—*Works of Rabelais*, standard trans. by T. Urquhart and P. A. Motteux, 1653, numerous editions; also trans. by S. Putnam, 1929; S. Putnam, *François Rabelais*, 1928.

RABIES. See HYDROPHOBIA.



RACCOON

RACCOON (*Procyon lotor*), a plantigrade animal of carnivorous habits found in every state of the United States, and also in Canada and in Central America. There is a South American species. A

“coon” looks much like a small gray bear except for the long ringed tail and the barred face. Raccoons live in hollow limbs or tree trunks, where they hibernate during the severest winter months, and in the spring produce four to six young. They choose trees near ponds and streams, being good swimmers, though not divers. They have the curious habit of washing everything they eat, and do this even in captivity. Their food includes mice, small birds and eggs, insects, fruit, nuts, crustaceans, clams and even stolen chickens. Raccoons are almost entirely nocturnal and are hunted at night. They are easily tamed.

Raccoon skin is one of the most durable furs. The most desirable skins are those with dark fully outlined stripes down the back and around the tail.

RACE, the collective name for a family, tribe or other group bearing kindred characteristics and reportedly descending from a common ancestor; see ANTHROPOLOGY: *The Races of Man*.

RACE MIXTURE. The miscegenation of the races of mankind is a phenomenon of great antiquity. There is evidence that as early as the late Paleolithic and certainly in the Neolithic period extensive mixture had occurred. Since much of the mixture of races has been between contiguous and allied stocks, the progeny of such crosses have escaped special distinction. In modern times an interest has been developed in the distinctive and isolated hybrids of divergent stocks. With the discovery of the New World and the expansion of geographical knowledge, various stocks from Europe poured into all corners of the earth; people never before in contact were for the first time brought together in intimate association. From these associations have arisen mixed populations, such as the Mulattoes in America, the Eurasians in India and China, the Dutch-Malay crosses in the East Indies, the mixed population in Hawaii, and the half castes of Africa. This catalogue might be made more detailed and more specific but it is enough to indicate the extent and size of the hybrid population which has been produced in the last few centuries.

The intensification of race prejudice in recent times has not prevented race mixture, but it has created situations of grave psychological and sociological consequence for the hybrid populations. Half castes are in general unfavorably stigmatized by one or both parental groups, although there are several notable exceptions to this. Part of the cause for the unfortunate position of the half caste may be attributed to the tendency for the less stable and the socially insecure elements of both groups to mix. The result has been that the offspring have been handicapped both by social and racial discrimination. Because of the delicacy of the social status of many half castes it is a field difficult to investigate, and very few adequate studies have been made.

The genetic aspect of race mixture was until the rediscovery of the mendelian principles of heredity without an efficacious methodology. The first classic work to be published in this field was in 1913 by

Prof. Eugen Fischer on the Rehobother Bastards, a group living in South Africa and the mixed progeny of Boers and Hottentots. Since then Rodenwaldt has investigated the half castes of Kisar, Davenport, the mixed population of Jamaica; Williams, the Maya-Spanish crosses, and Shapiro, the Polynesian-European mixtures, including the descendants of the mutineers of the *Bounty*. Although much still remains to be done, it has been found that the genetic laws discovered in experimental animals and plants frequently applies to man as well. Furthermore these studies on mixed populations have shown that the hybrid is often superior in fertility and is characterized by "hybrid vigor" H. L. S.

RACE PSYCHOLOGY, a branch of genetic psychology; the psychology of races. In its broader meaning race psychology refers to the origin and development of mental life from its lowest to its highest forms. This includes not only man but the animals. The evolution of mental life is the subject matter of race psychology in this sense. It is a division of genetic, and includes comparative, psychology. It is much broader in scope than folk psychology, which confines itself to primitive human groups.

In its narrower sense, race psychology is identical with ethnic psychology. Here the interest is in the psychology of races, their differences, their characteristics, their similarities and their traits. Considerable attention may also be given to racial mixtures. Race psychology in this sense treats of the psychological aspects of ethnology.

RACES, EQUALITY OF. Like the recurrent styles in women's dress or in the cut of men's coats, the whirlwind of public interest picks up first one dormant scientific controversy, tosses it about violently for a time, drops it in much the same place as it was found, then passes on to others. Such a catalogue of intermittently active subjects would include Evolution vs. Creation, Cycles of Civilization, Heredity vs. Environment and the Inequality of Races. No one knows who first initiated this discussion. Probably some prehistoric boaster began it by pointing out the superiority of his cave and his associated cave-dwellers over all other caves and their inhabitants. Certainly we know that to the Greeks the non-Greeks were barbarians. The Chinese similarly condescended to the rest of the world. Nor has Europe been free from this attitude. One may regard such a point of view as an extension of a very common human characteristic, and perhaps argue pragmatically that it has served a useful purpose. It remained, however, for Gobineau in France and Chamberlain in Germany to attempt a scientific justification for the belief in the superiority of a special race.

During the last decade the inequality in the natural endowment of the races of mankind was again championed by Madison Grant and Lothrop Stoddard in America and Gunther, among others, in Germany. The race favored by these men was the blond Nordic of northern Europe. According to extreme believers in this doctrine all that is note-

worthy in European civilization has been contributed by men of the Nordic race. Much emotional heat was aroused by this dogma, which has been bitterly attacked by a number of anthropologists. Actually very little is known about the mental equipment of the races of man. Recently psychological testing has been undertaken on a large scale among a number of different races. The results of such investigations have been criticized both by psychologists and by others who doubt the efficacy of the tests employed. An unbiased conclusion would concede that there is little or no objective evidence for the thesis that races are unequally endowed with intellectual ability.

From the anatomical point of view it is extremely difficult to arrange a hierarchy of races. The races of man are not consistently advanced for all traits nor homogeneously primitive. The primitive character of a specific trait may not necessarily be an index of a lowly status in evolution; it may on the contrary represent a generalized and useful condition. The Negro, for example, although prognathic and therefore closer to the anthropoid state, has thick, everted lips and kinky hair which are far removed from the ancestral simian condition. H. L. S.

RACES OF MANKIND. In the vast welter of living organisms one would be hopelessly embogged without a nomenclature. But a name for each individual would not be of material assistance; therefore man, long before the zoologist appeared, grouped various classes of animals under generic names such as horse, dog and elephant. The basis for these categories was simply obvious resemblances which were heritable. Essentially the systematic zoologist differs but little in his procedure. He attempts to find patterns of variation that are inherited. These he fits into larger patterns. At the time of Linnaeus a system of classification was codified and standardized. Animals and plants were divided into species, and, from these, more generalized groupings were made of genus, family, order and phylum. With the appearance of Darwin a framework was provided into which these classifications might be ordered into an evolutionary series.

Man, too, presents a great variety of forms which nevertheless appear in definite patterns. To avoid the "species" controversy and to be free to deal with traits not usually employed by systematists, the physical anthropologist prefers to divide mankind into races. Hooton has defined race as "a great division of mankind, the members of which, though individually varying, are characterized as a group by a certain combination of morphological and metrical features, principally non-adaptive, which have been derived from their common descent." It is significant that a combination of features is particularly specified. Attempts to divide man on the basis of one character alone have been abortive, for a single trait does not furnish a sufficient number of distinctive variations, nor is it equally diagnostic for all races.

Distinguishing Characteristics. The criteria employed in the classification of races are of unequal

value. A character such as stature, which is subject to limited modification by the environment, would have less validity than hair form, which apparently retains its peculiar structure through environmental changes. The latter is called a non-adaptive and the former an adaptive character. The traits most commonly recognized in the classification of races may be summarily enumerated. Hair is one of the most important of racial criteria; the color, form and distribution are frequently observed. The color, shape and skin-folds of the eye and the color of the skin are also generally utilized. Other observations are made on the form of the nose, the lips and facial profile, on the proportions of the head (cephalic index) and face; on the character of the teeth. Combinations of these characters and many others serve to distinguish one race from another.

The physiological criteria of race are unfortunately scanty. With increased investigations of racial differences in physiology we may expect to expand our list of satisfactory tests of race. At present, however, there are only a few that are serviceable. In 1900 Landsteiner discovered that the sera of certain bloods agglutinated the cells of others. From this reaction he was able to distinguish four blood groups. During the World War, the Hirsfelds made extensive investigations of race differences in blood groupings. Since then a large number of studies have been effected which show that the various races differ in the percentages of each group that is found in their bloods. (See BLOOD GROUPS.) Some evidence is accumulating that races also exhibit different pulse rates and temperatures. The metabolic rates of several races, which have been so tested, have shown differences. In a number of other directions as well suggestive evidence is beginning to appear that races vary physiologically. Some of these differences may be environmental in origin, but others are probably non-adaptive. For example, races differ in their rate of growth, onset of puberty, resistance to disease and reaction to drugs.

The psychological characteristics of the races of man are still very inadequately explored. One school holds that there are no psychological correlates with physical races. Another, mainly engaged in surveying racial groups by means of various psychological tests, maintains that mental differences do exist. But at present the results of these investigations have nothing to offer the student of racial classification.

Using a single trait or a battery of them, anthropologists have devised innumerable schemes for the classification of man. The diligent reader might by careful perusal of the literature find a great many elaborate systems, each strenuously defended by its creator, but all differing in more or less degree. The classification advanced here is not original, but it does attempt to avoid unnecessary complexities and to include essential distinctions.

The simplest and most persistent division of man is the five-fold classification, based on skin color: white, yellow, red, brown and black. This has been re-

duced by some to three: white or Caucasian, yellow or Mongoloids, and blacks or Negroes. These groupings, however, are insufficient and omit a number of distinct stocks which cannot be conveniently arrayed within such a limited range. The Australian aborigine, for example, is black in skin color but is not negroid. Preserving these names, because they are useful, we may regard them as representing great divisions of mankind which can be further divided into races.

Caucasoid Group. The White, European or Caucasoid group can be conveniently subdivided into the Nordic, Alpine, Mediterranean, Armenoid, Dinaric, East Baltic, Arab and Berber races. The Nordic or Teutonic is best represented by the Swedes, Norwegians, north Germans, and by certain strains in Great Britain and America. The hair color is blond; the eyes are blue; the hair is straight or wavy and is absent or moderate on the body; the head is narrow in proportion to its length; the face is similarly narrow; the nose is also long and narrow and usually straight, and the stature is above medium. The Alpine race is particularly characteristic of central Europe, eastern Europe, the Balkans and to a limited extent, in the rest of Europe. The stature is medium or below; the head and face are broad and short; the eye color is brown; the hair is brown to black in color and straight or wavy in form and abundant on the body; the nose is moderately wide, and the skin color is brunette white. The Mediterranean is found typically among southern Italians and Spaniards, among Portuguese, generally throughout the Mediterranean basin, and mixed with other stocks in Great Britain and France. The hair is wavy or curly and black; the color of the eyes is dark brown; the pigmentation is olive or light brown; the shape of the head is narrow and of the face oval, the nose is narrow and straight or aquiline, and the stature is short. The Armenoid racial stock is found in southwestern Asia and spilling over into southeastern Europe; typical Armenoids are the Armenians themselves, Syrians, Persians, Kurds and Turks. The most striking racial characteristics of this group are the short wide head with a flat occiput rising above medium height, heavy convex nose with depressed tip and prominent alae, brown eyes, brown or black hair, heavy growth of hair on face and body, dark white skin color, and a tendency to corpulence in maturity. A number of other races are sometimes distinguished among the White group by the finer division of one of the above races or by the recognition of a mixed type as having attained a stable recombination of the characteristics of two or more primary races. Among these mention may be made of the following. The Dinaric or Adriatic, exemplified by Montenegrins, Albanians and Bosnians, has an Armenoid shaped head and nose, but is tall and frequently has hazel or blue eyes as well as brown. The East Baltic is found in the countries bordering the Baltic: Finland, Estonia and parts of Scandinavia, of Germany and of Russia. The hair is yel-

low, but combined with a broad head and face. In body build this type resembles the Alpine, being short and stocky. The eye color is a very light brown or blue; the hair is straight, and the nose is concave in profile with a sharp up-tilted tip. The Arab and the Berber are dignified as distinct races by some, but, in general, they may be described as similar to the Mediterranean but distinguished from them by a darker skin color. The people of northern India are a mixed group; but their nearest relation appears to be with the Arab-Berber-Mediterranean stock which has a more or less continuous distribution from southern Spain to northern India.

Mongoloid Group. The Mongoloid group inhabits eastern Asia and, if we include the American Indian, North and South America. This branch, however, of the human species contains at least two Asiatic races: the Mongol and the Malay. The former is found mainly in northern and central Asia and is represented by such tribes as the Buriats, the Kalmucks and the Tungus. The same race is found in China, where it is predominant in the north among the Manchus and gradually fades toward the south. The Japanese, too, have a large Mongol element in their racial composition. The pattern of traits peculiar to the Mongols are, primarily, narrow eyes, often tilted upward at their outer corner and at their inner corner covered with a fold of skin, called the epicanthic fold; short, broad heads; short, wide faces with prominent malars; medium wide noses, which at the root are almost on the same plane with the cheek bones and the eyes; yellowish skin color and in some cases almost white; black hair sparse on the body and face. The stature is medium; the trunk is proportionately long with small buttocks. The Malay is frequently regarded as a non-Mongoloid race, but, with the exception of a few features such as epicanthic fold and yellow pigmentation, both of which may be environmental responses, it shares many characteristics with Mongoloids. The hair is straight and black and but sparsely developed on the face and body; the head is brachycephalic or wide in proportion to its length; the face is short and wide with prominent malars; the eyes are dark brown and prominent as in all Mongoloids and are sometimes tilted upwards at their outer corners. Malays are best represented in the Malay Archipelago, but the same stock is found mixed with Japanese, Filipinos and some Indonesians.

The American Indian is usually classed as a single race, subsidiary to the Mongoloid branch of man; but closer inspection reveals the presence of several distinct strains which merit the status of sub-race, if not of race. Unfortunately, however, our knowledge of large groups of Indians, especially those inhabiting the Amazon country, is still very fragmentary. The Mongoloid affinities of the American Indian are betrayed by his straight, coarse black hair, which is sparse on the face and body; his prominent malars or cheek bones, and by his relatively long trunk with small buttocks and narrow pelvis. With respect to

his head form, face form, nose form and stature, it is possible to make further subdivision of the American Indian into a Palae-American with short stature, narrow head and face; a Neo-American with wide head and wide face with prominent malars; and a Woodland type with tall stature, narrow to medium wide head, and long and broad face. The first of these are represented by the prehistoric Basket Makers of the Southwest, some of the Amazonian tribes and the Yaghans of Terra del Fuego. The second is happily typified by the Pueblo Indians of Arizona and New Mexico, and the third by the Iroquois and Algonkin. The Eskimo, inhabiting the northern fringe of North America, are Mongoloid. But to my mind they lack sufficient homogeneity to be designated as a race. More often than not the head is decidedly narrow with a keel-like development along the median sagittal plane of vault; yet the type varies from the East to the West and appears to be best explained as a modified Mongoloid stock continuous with its Asiatic relatives but modified by American Indian infiltration.

Negroid Group. The Negroid division of mankind constitutes a large section of the human race. It is native to Africa and Melanesia, but is also widely distributed in North and South America. Of the various related Negroid races, the Negro of West Africa, otherwise known as Negritian and Forest Negro, is perhaps the most typical. His home is in the Congo, west coast of Africa, and the Sudan, and he is represented best in such tribes as the Tshi, Ewe and Ibo-speaking people. Features characteristic of this race are: black, woolly hair; dark brown or blackish pigmentation; pronounced prognathism; broad, low, everted lips; narrow head form; hair scanty on the body; forearm and shin relatively long, and stature above medium. The Melanesian or Oceanic Negro lives in New Guinea, New Hebrides, Solomons and other archipelagoes in Melanesia. He is characterized by traits similar to those found among the Negroes of Africa, but in addition has a heavily developed brow ridge with a depressed nasal root, approaching in this respect the Australian aborigine. Frequently among Melanesians the nose is convex in profile and rather more prominent than among African Negroes. In some classifications the dwarf people of Oceania and Africa are severed into two races. It seems wisest, however, to consider them as one until more adequate information is available. Therefore we shall speak of the Pygmy or Negrito race as inclusive of such typical groups as the Pygmies of the Congo, the Tapiro of Melanesia, the Semang in the Malay Peninsula and the Aetas of the Philippines. Their most distinctive feature is, of course, a diminutive stature which rarely averages more than 150 cm. In addition, their head form is moderately wide, their nose extremely broad and flat, and their development characterized by the retention of a number of infantile traits. In other respects they are similar to Negroes. The Tasmanian, recently extinct, in some ways is reminiscent of the Pygmies, ex-

cept for stature which is medium. The Nilotic is really a sub-race and is especially characterized by a very lofty stature, 175 to 180 cm., a very slender body and thin legs and a reduction of the marked negroid prognathism and platyrrhiny. The Nilotics include the Dinka, Shilluk, Lango and related people inhabiting Eastern Sudan and the Lake Region of Africa. The East Coast Negroes are considered by some anthropologists to be distinct from the West Coast Negritian principally in a number of cranial characters. In the refuge areas of South Africa are the remnants of a group once widespread. These are the Bushmen and their relations, the Hottentots. The difference between them is not great, and for the sake of simplicity we shall describe them as one race. Particularly noteworthy is their small stature, about 144 to 150 cm. In this they resemble the Pygmies, but they differ in other ways. Their skin color is yellow brown; their hair is distributed over the head in small, isolated, tightly-rolled clumps and is known as "pepper corn"; their faces are triangular with projecting malars; their eyes are narrow and frequently have epicanthic folds, and their noses are very flat at the bridge and wide at the nostrils. In one other development they are unusual; that is the extreme accumulation of fatty deposits in the buttocks, a condition known as steatopygia.

Other Groups. In the threefold division of mankind mentioned above there is no provision for several groups of people who, nevertheless, are distinctive enough to merit separate classification. The most important among these are the Australians. They are the aborigines of Australia and are found in their purest form in that continent. In parts of Melanesia, particularly New Guinea, the same element is found again, but mixed with other populations. An Australoid type has also been claimed to have existed in Africa. In many respects the Australian is one of the most primitive of existing races and rather reminiscent of Neanderthal Man in Europe. Especially noteworthy in the Australian is the development of the brow ridge, a heavy torus of bone across the forehead just above the eyes. Associated with this primitive bony bar on the forehead is an extremely wide, low-bridged nose whose root is deeply depressed. The head is usually very narrow in proportion to its length; the face juts out in profile, a condition known as prognathism; both the skin color and eye color are dark brown as in Negroes; the hair, unlike that of Negroes, is abundant on the face and body and is wavy or curly, never frizzly or woolly. In body build the Australian tends to be slender and of medium height with a very short trunk.

The Polynesian is another group worthy to be called a race. These people are far-flung among the scattered archipelagoes of the western Pacific, from Hawaii to New Zealand and from Samoa to Easter Island. Between these limits are the Marquesas, the Society Islands, the Australs, the Cooks, the Tuamotus and the Tongan Islands. In origin the Polynesian is without doubt a mixture of several continental races; but

the exact ingredients of the mixture are still uncertain. There is excellent evidence that among the racial strains which go to make up the Polynesian the White or Caucasoid is important. Another is Mongoloid. A third is claimed by some to be Negroid. Whatever the antecedents of the Polynesian, he does exhibit certain basic similarities throughout the area. These include a tall stature; a well-proportioned and muscular body build which runs to obesity in maturity; a large, broad head with a narrow and often high forehead; a large, broad face; a light brown skin color; straight to wavy hair, and a moderately large, fleshy nose.

A curious group living in northern Japan, called Ainu, is frequently regarded as a distinct race belonging to the White group of races. Once more widely spread in the Japanese Archipelago, they are now reduced in number and are restricted to the less favorable sections of northern Japan and to Saghalien. Their location in the eastern outskirts of Asia, separated from other Caucasoid groups, is rather mysterious; but future archaeology will probably reveal some hidden links to connect them with their western relatives. Although in many ways the Ainu is characteristically Caucasoid in his affinities, his isolated position and a Mongoloid strain particularly evident in the women, make it wiser to hold his exact affiliations in abeyance. The epithet "hairy" is applied to the Ainu because of a striking abundance of hair on the head, face and body, a condition never found among Mongoloids. The skin color is dark white; the hair is straight or wavy and black; the eye color is dark brown, and the eye itself lacks the epicanthic fold in males. The head form is moderately narrow and has a prominent development of the brow ridge.

There are in addition to the above a number of populations which are sometimes dignified as races. Among these are the Dravidian of central and south India and the Indonesian, scattered among the numerous islands of Indonesia. They represent a mixture of other stocks, but vary too much from place to place to present even the limited homogeneity necessary to be distinguished as races.

H. L. S.

BIBLIOGRAPHY.—J. Deniker, *The Races of Man*, 1900; C. Wissler, *The American Indian*, 1922; A. C. Haddon, *The Races of Man and Their Distribution*, 1925; L. H. D. Buxton, *The Peoples of Asia*, 1925.

RACHMANINOFF, SERGEI VASSILIE-VITCH (1873-), Russian pianist and composer, was born at Novgorod, Apr. 2, 1873. After studies at the Moscow and St. Petersburg conservatories he made his début as a pianist, rapidly winning international renown for his scholarly interpretations. He conducted at the Imperial Opera in Moscow during 1904-06. In 1909 he gave his first recital in the United States, and settled in New York. His popularity as a composer was initiated with his *Prelude in C-sharp minor* (op. 3, no. 2), one of his many works for the pianoforte. His more ambitious works include three one-act operas, *Aleko*, *The Miser Knight*, and *Franческа da Rimini*, two symphonies, three pianoforte concertos, and a large collection of songs.

RACINE, JEAN BAPTISTE (1639-99), French dramatist and poet, was born at La Ferté-Milon, Dec. 21, 1639. Excelling in classical studies, he began to write at an early age, several poems and plays preceding his first real success, achieved in 1667 with the production of *Andromaque*. The next year *Les Plaideurs* was produced, a succession of masterpieces following in quick succession. These included *Britannicus*, *Bérénice*, *Iphigénie* and, in 1677, *Phèdre*, one of the greatest treasures of the French theater and still in the repertoire of French tragic actresses. In 1673 Racine was elected to the French Academy, and soon afterward retired, desiring to enter a monastery and failing to do so only because of the remonstrances of his friends. For 12 years the poet remained in seclusion with his family, and it was only at the request of MADAME DE MAINTENON that Racine once more took up his pen and wrote two plays founded on Biblical subjects, *Esther* and *Athalie*. He died in Paris, Apr. 26, 1699.

BIBLIOGRAPHY.—A. M. Duclaux, *Life of Racine*, 1926.

RACINE, a lake port city in southeastern Wisconsin, the county seat of Racine Co., situated on Lake Michigan, at the mouth of the Root River, 25 mi. south of Milwaukee. Bus lines, lake steamers, airplanes and three railroads afford transportation. Farm crops, dairy products and lumber are shipped by rail and water from Racine. Racine is also an important manufacturing center, the second largest city in the state and the seat of Racine College. In 1929 the factory output amounted approximately to \$132,000,000; the retail trade reached a total of \$41,510,581. In 1834 a group of settlers came to the mouth of the river; the village was known until 1837 as Port Gilbert. Racine was chartered in 1848. Pop. 1920, 58,593; 1930, 67,542.

RACKETS or **RACQUETS**, a game played on an indoor court, with a bat resembling a tennis racket, about 2½ feet long, and with cloth balls bound with twine, 1 inch in diameter and 1 ounce in weight. The court should be cement, and measure 60 by 30 feet. Front and side walls should be 30 feet high, and the back wall 15 feet high. Singles or doubles may be played. In the former game the server, standing in his service box 35 feet from the front wall, strikes the ball so that it hits the front wall above the service line, which is marked by a white stripe 9 feet, 7½ inches from the floor. His opponent may return the ball to the wall before it strikes the floor, or after the first bounce. Only the server may score a point, or ace, and game is 15 aces. The serve goes to the winner of the last stroke. Rackets is extremely popular in England, and in the United States a limited number of players compete annually for the national singles and doubles championships.

RADCLIFFE, MRS. ANN (1764-1823), English novelist, née Ann Ward, was born in London, July 9, 1764. She was married in 1787 to William Radcliffe, who subsequently became editor of the *English Chronicle*, and two years later she published her first novel, *The Castle of Athlin and Dunboyne*. From

the first she was much influenced by *The Castle of Otranto*, a romantic work in the so-called Gothic manner by HORACE WALPOLE. Her outstanding novel was *The Mysteries of Udolpho*, 1794, a tale of horror replete with a pseudo-medieval atmosphere, supernatural effects and romantic tragedies. As a novel of sheer horror *Udolpho* has a distinct place in the development of ROMANTICISM. Among Mrs. Radcliffe's other works are *A Sicilian Romance*, 1790, *The Romance of the Forest*, 1791, *A Journey Through Holland and Germany*, 1795, *The Italian*, 1797, and *Gaston de Blondville*, posthumously published in 1826. The modern interest in the MYSTERY STORY has done much to bring Mrs. Radcliffe again into fashion. The romancer died in London, Feb. 7, 1823.

BIBLIOGRAPHY.—C. F. MacIntyre, *Ann Radcliffe in Relation to her Time*, 1920.

RADCLIFFE, JOHN (1650-1714), English physician, born at Wakefield, was appointed physician to Queen Anne of Denmark, but lost this post because of his overbearing manner. He left funds to Oxford for the present foundations known as the Radcliffe Library, the Radcliffe Infirmary, the Radcliffe Observatory, and the Radcliffe Traveling Fellowship. To his successor, Dr. Richard Mead, he said relative to making a fortune, "use all mankind ill." He died at Carshalton on Nov. 1, 1714. M. F.

RADCLIFFE COLLEGE, a non-sectarian institution for women at Cambridge, Mass., affiliated with HARVARD UNIVERSITY. The founding of the college in 1879 was an outgrowth of the suggestion of Arthur Gilman and his wife, residents of Cambridge, that women be given instruction in the regular university course by Harvard professors, but in separate classes from the men. The first group of students was known as the Society for Collegiate Instruction of Women. This society was incorporated in 1894 as Radcliffe College, being named after Ann Radcliffe, Harvard's first woman benefactor. From 1903-23 the dean of the Faculty of Arts and Sciences in Harvard was also the president of Radcliffe. In 1924 a full time president was elected. Radcliffe has adopted the educational methods instituted at Harvard. The courses are the same as those at the university and are given by members of the Harvard faculty. Many of the graduate courses are given at Harvard, and the laboratories of the university are used to a considerable extent. The requirements for admission and degrees are the same, and Radcliffe diplomas are countersigned by the president of Harvard. Radcliffe grants the degree of Ph.D. The college had productive funds in 1931 amounting to \$4,109,990. The library contained 68,000 books. In 1931-32 there were 1,053 students and a faculty of approximately 300, headed by ADA LOUISE COMSTOCK.

RADEK, KARL (1885-), Russian Communist, was born in Lvov, Austrian Poland, in 1885. He studied at the Universities of Cracow and Berne. In the 1905 Revolution he was imprisoned for participation. During the World War he conducted anti-military propaganda, first in Germany and later in Swit-

zerland. He conferred with Lenin in 1917 and later as party representative established a propaganda bureau in Sweden. In 1919 he was imprisoned in Germany for anti-Government activities. His efforts toward a revolution in Germany by his fellow Communists were frustrated by the loans to Germany made by foreign powers and his failure cost him his position as a member of the Central Executive Committee. In 1927 he opposed Stalin's policy of compromise and was deported to the province of Vologda as a disciplinary measure.

RADFORD, a city in southwestern Virginia, in Montgomery Co., situated about 15 mi. northeast of Pulaski, on the New River, between the Allegheny and the Blue Ridge Mountains, served by bus lines and the Norfolk and Western Railroad. Grain and livestock are raised in this region. The local manufactures are cast iron pipe, veneer and men's shirts. Coal is mined nearby. It is the seat of a state Teachers' College. Redford was incorporated in 1892. Pop. 1920, 4,627; 1930, 6,227.

RADIAL GASOLINE ENGINES. Modern aircraft engines are of the radial, rather than rotary type. The cylinders are, as in the **ROTARY ENGINE**, placed radially, but are rigid, while the pistons reciprocate and turn the crankshaft. See **AIRCRAFT ENGINE**.

RADIAL VELOCITY, in astronomy, the speed of a celestial object in the line of sight as measured by a spectroscope. Treating light as a wave motion, Doppler's principle demands that when the source of light is approaching, the observer receives more waves per second than he would otherwise, the pitch of the light waves appears higher, and the color of the light bluer; if the source is receding the light will appear redder.

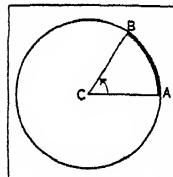
As a difference in degree of color this could not be detected, and the actual measurement is done in the following way. When the light of a star is spread out over a **SPECTRUM**, a number of black lines appear in it, which can be identified as due to certain chemical elements known on earth. The normal position of these lines is accurately known. In the observation of the radial velocity of a star its spectrum is photographed alongside a spectrum of, say, iron. The lines in the star's spectrum due to iron are identified, and matched with those of the terrestrial iron. If the stellar lines be displaced toward the violet, the star is approaching; if they be displaced toward the red, the star is receding from us. In either case the amount of displacement will give a value for the star's speed.

In this way the radial velocities of thousands of stars have been determined and it has been found that the majority of them are about 15 to 25 miles a second, though occasionally very large velocities may be found, ranging up to nearly 300 miles per second. For bright stars with sharp spectral lines an accuracy of a few tenths of a mile may be reached in these observations; for faint stars the uncertainties may sometimes reach 3 or 4 miles per second, and even

more if, as is often the case, the lines are broad and indistinct.

W. J. L.

RADIAN, the central angle of an arc equal in length to the radius of the circle. In this figure the arc AB has the same length as the radius CA . Hence $\angle C$ is one radian. Since the circumference (360°) is equal to $2\pi r$, therefore $2\pi r = 360^\circ$, and $r = 360^\circ/2\pi = 180^\circ/3.14159 \dots = 57.3^\circ$, approximately. In advanced mathematics it is often more convenient to use radians than to use degrees.



RADIATION, RAYS. There are two general classes of radiation emitted by various bodies: that termed **ELECTROMAGNETIC WAVES**, including radio, heat or infra-red rays, visible light, ultra-violet light, x-rays, gamma rays and cosmic rays; and that called corpuscular radiation, such as high-velocity **ELECTRONS** (cathode, Lenard and beta rays) and **POSITIVE RAYS** or mass rays (alpha and canal rays) (see **CATHODE RAYS**; **BETA RAYS**; **ALPHA PARTICLES**).

The various radiations classified as electromagnetic are all known to be of the same fundamental nature, inasmuch as they obey the laws of **REFLECTION**, **REFRACTION**, polarization (see **POLARIZATION OF LIGHT**) and interference (see **INTERFERENCE OF LIGHT**) and travel through space with the same velocity, 2.998×10^{10} cm. per sec. Their wave-lengths differ widely, ranging from several miles for wireless waves to a few million-millionths of a centimeter for cosmic rays (see **ELECTROMAGNETIC SPECTRUM**). They blend together from one to the other, except for an unexplored region between gamma and cosmic rays. According to the **QUANTUM THEORY**, these waves are made up of bundles, or quanta, of energy called **PHOTONS**.

Whereas electromagnetic waves are not deflected from straight-line paths while going through electric or magnetic fields, corpuscular rays are more or less easily deflected, indicating that the latter are electrically charged. The corpuscular rays are known to possess definite amounts of inertia or mass, and also to have associated with them a wave-like property. This apparent paradox has been greatly clarified by the theory of **WAVE MECHANICS**. See also **ELECTRICITY**; **LIGHT**; **SPECTROSCOPY**.

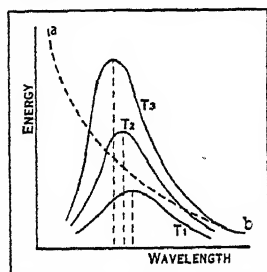
J. B. H.

RADIATION, THEORY OF, a principle of physics dealing with the emission and transfer of energy through regions not occupied by ordinary matter, or through matter not affected by the transmission. Two types of radiation are definitely recognized, though both may be present at any one time. These are **LINE SPECTRA** and radiation by bodies by virtue of their temperature (see **RADIATION OF HEAT**). The most important case is that of a black body, i.e., a body which absorbs all radiation falling upon it (see **BLACK BODY RADIATOR**). The transfer of the energy is assumed to be by **ELECTROMAGNETIC WAVES**, though no assumptions as to theory are necessary for many important relations.

Intimately associated with radiation is the subject

of absorption (*see* ABSORPTION OF LIGHT). The coefficient of absorption is the ratio of the energy absorbed to the energy of the incident radiation. The coefficient of emission is the energy radiated per unit area per second. The following laws can be proved and checked experimentally: 1. Since a good absorber is a good radiator, and since the ratio of the coefficient of emission, E_1 , of a body to its coefficient of absorption, A_1 , is the same for all bodies, then $E_1/A_1 = E$, the coefficient of emission of an ideal black body. 2. Radiation produces a pressure in the direction of propagation numerically equal to the radiation energy per unit volume. In the case of disorganized radiation, as within a heated body, the pressure is $\frac{1}{3}$ the radiation density. 3. Radiation from a black body is proportional to the fourth power of the absolute temperature (*see* ABSOLUTE TEMPERATURE SCALE).

The energy-distribution curves for a black body are of great interest and are of the form shown for three temperatures. Wien demonstrated that, as the temperature of a body increased, the wave-length at which maximum energy appeared became shorter in accordance with the relation, $T = c$ (*see* figure). All theoretical attempts to find the equations of the curves led to curves of the form of the dotted line, ab , indicating that the energy



ENERGY DISTRIBUTION CURVES
FOR A BLACK BODY

becomes greater for shorter wave-lengths, without limit. This is directly contrary to observation. A satisfactory equation, finally obtained by Planck, follows:

$$Ed\lambda = \frac{c_1}{\lambda^5} \cdot \frac{1}{e^{\frac{c_2}{\lambda T}} - 1} d\lambda$$

where $Ed\lambda$ is the energy in the region of width $d\lambda$ at wavelength, λ , e is the base of the Naperian logarithms and c_1 and c_2 are constants. This equation fits the experimental curves within the limits of observation. In order to obtain it, however, Planck had to assume that energy, contrary to former belief, is not infinitely divisible, but comes in definite units, called quanta, and their integral multiples (*see* QUANTUM THEORY). The energy in a quantum depends on the FREQUENCY of the radiation in accordance with the relation, $E = h\nu$, where ν is frequency and h is Planck's constant (*see* PLANCK'S LAW). It is very difficult to reconcile some of the implications of this quantum idea with the wave theory, but since its inception the quantum theory has been playing an increasingly important part in the explanation of physical phenomena which appear to be wholly without explanation on any other basis. The theory has been especially fruitful in the field of line spectra, and is the basis of all modern explanations in that extremely complex field.

P. I. W.

BIBLIOGRAPHY.—Wood, *Physical Optics*.

RADIATION OF HEAT, the process by which HEAT is transferred from a hot body to a colder body without heating the intervening medium. In CONDUCTION OF HEAT there is a continuous temperature gradient from the hot to the cold body, in CONVECTION OF HEAT the heat is transferred by motion of the medium, but in radiation, neither of these phenomena occurs. The medium may be colder than either radiator or absorber, and no material connection is necessary. Heat is radiated through empty space from the sun to the earth. As ordinarily used, heat refers to the energy of the MOLECULES of a substance. Since the medium, if any, is not heated, it is ENERGY rather than heat which is transferred by radiation.

The term *radiation* has come to be used in two senses: as the name for the process by which radiant energy is transferred; and as a synonym for radiant energy. In this latter sense, radiation includes not only LIGHT and heat energy, but also ULTRA-VIOLET RADIATION, X-RAYS, GAMMA-RAYS and COSMIC RADIATION, at one end of the SPECTRUM, and ELECTROMAGNETIC WAVES, at the other end. "Radiant heat" lies chiefly in the infra-red part of the spectrum.

The amount of heat energy radiated per second from a given area depends upon the temperature and the nature of the surface. The net loss depends also upon the surroundings (*see* PREVOST'S THEORY OF EXCHANGES). Rough, dark surfaces are good radiators; light-colored, polished surfaces are good reflectors but poor radiators. Newton's law of cooling states that the rate at which a body cools is proportional to its excess in temperature above its surroundings. This is an approximation which holds only for small temperature differences. The accurate laws of radiation are STEFAN'S LAW, WIEN'S LAW and PLANCK'S LAW. *See* also BLACK BODY RADIATOR. W. W. S.

RADIATION PYROMETERS measure the temperature of a body by the total radiation, both LIGHT and HEAT, which it emits. While the details of the instruments differ widely, the general principle is the same in all. By a suitable MIRROR or TELESCOPE, the radiation from the hot body is brought to a focus on the junction of a THERMOCOUPLE. This is connected to a suitable indicating instrument or millivoltmeter. The temperature of the thermocouple junction, and hence, the electromotive force which it sets up, is determined by the radiation which is concentrated upon it, and this, in turn, depends upon the temperature of the hot body. Hence, the indicating instrument can be calibrated to read temperatures directly. By suitable focusing devices, the readings are made independent of the exact distance of the instrument from the furnace. However, unless an instrument has been especially calibrated for a particular set of conditions, it always indicates "black body temperature," i.e., the temperature of the BLACK BODY RADIATOR which would emit radiation of the observed intensity. Consequently, the temperature of such a thing as a hot steel ingot, obtained by a radiation or by an OPTICAL PYROMETER, must be corrected for the EMISSIVITY of the surface. W. W. S.

RADIATORS, the heat-distributing element of a steam or hot-water heating system. Radiators are made in many different forms and sizes. The older types were usually made of cast-iron and were exposed in the room to be heated. Later designs have included fin, or extended-surface, elements made of various metals and enclosed in cabinets. Radiators are rated in square feet of radiation, which unit originally meant a square foot of external surface but now means a heat emission capacity of 240 British Thermal Units per hour. The name "radiator" is misapplied, as only about 30% of the total heat from an exposed radiator, and about 15% of that from the cabinet type, is given off by radiation, the remainder being transmitted by *convection*. A radiator is considered to be most effective if placed along the wall having the greatest heat loss. This prevents cold drafts across the floor and gives a more even temperature distribution from floor to ceiling.

Also, a piece of special HEAT EXCHANGE EQUIPMENT to cool INTERNAL COMBUSTION ENGINES. F. B. R.

RADIC, STJEPAN (1871-1928), Croatian patriot and Yugoslav political leader, born at Debarjevo near Fiume, July 11, 1871. After being twice imprisoned for anti-Hungarian activities, he was occupied at Semlin as correspondent for several newspapers, and in 1902 settled in Zagreb (Agram). Here he created the powerful Croatian peasant party. Although Radic had been an Austro-Hungarian legitimist during the World War, in 1919 he demanded a republican government for Croatia and its union with Serbia and Montenegro. He incurred repeated imprisonment because of his vigorous championship of the rights of Croatia against the policy of extreme centralization by the Serbs. Despite his ardent insistence on the rights of Croatia he nevertheless supported Alexander I, although the revival of an intense Serbian movement at Belgrade again forced him into opposition and obstructionist tactics in and out of the Skupština to secure the liberties of his beloved Croatia. During the bitter struggle that ensued he was shot by the Serbian radical, Racic, June 20, 1928.

RADICAL, a word derived from the Latin *radix*, root, and used in mathematics to refer to the roots of numbers. It is often used to mean merely the sign $\sqrt{}$, but strictly speaking it means an expression of a root, such as $\sqrt{4}$, $\sqrt[3]{7}$, $\sqrt[4]{xy}$, or $\sqrt{a^2 + b}$. In the expression $\sqrt[n]{x}$, n is the index of the root. If n is not stated, 2 is understood; that is, $\sqrt{7}$ is the same as $\sqrt[2]{7}$.

RADICALISM, a term used to denote the extreme advance wing of any movement—political, economic, social, religious, racial, sexual or aesthetic. Its derivation indicates reference to those who attack the roots of a problem and demand basic change, but its use is more indiscriminate. In political movements it commonly describes the left opposition to the government, usually based on the interests of peasant and working classes. In economic usage, radicalism conveys a class program and is currently applied to Com-

munists, as it previously was to anarchists and to Socialists when those movements occupied the left of the stage of struggle.

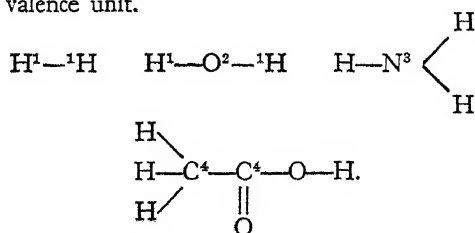
The term is relative. To conservatives any movement critical of the existing system is radicalism. To liberalism, the philosophy of tolerance and gradual reform, radicalism represents a program of measures intended to change substantially the existing order, either with or without a revolutionary goal.

These three viewpoints, conservatism, liberalism and radicalism, run through all social movements, with relative meanings. In general they are words merely descriptive of those who want a sweeping change. Among movements labelled as radicalism in common usage, are degrees of difference and antagonism which make the word objectively meaningless. R. N. BA.

BIBLIOGRAPHY—B. Russell, *Roads to Freedom*.

RADICALS, FREE CHEMICAL. Free chemical radicals are a class of substances of recent discovery and, until the number became fairly large, they were considered as exceptions to some of the accepted theories of molecular structure. Matter is made up of discreet particles, all alike among themselves in each pure substance but different for every kind of substance. These submicroscopic particles, *molecules*, are about 0.000000012 in. in diameter, and yet each individual molecule still retains the *chemical* properties of the substance under consideration. The molecules are made up of still smaller particles, the *atoms* of the elements, some 90-odd of which are known to us at present. Whether the number of atoms in the molecule be small or large, the atoms therein are linked to each other in an orderly fashion, since an atom of each element can be in *direct combination* with only a definitely limited small number of other atoms. In this respect all the 90-odd elements fall into eight groups, in accordance with the so-called periodic system of classification of the elements (see Periodic System). An atom of an element from Group I can be in direct combination with only one other atom, and thus has a *valence* of one; an atom of elements in Group II can be linked to two atoms of Group I or to one of Group II, and is bivalent; of Group III is trivalent, etc., up to heptavalency.

The following formulas illustrate the combination of the atoms in the molecules of the substances—hydrogen, water, ammonia, acetic acid, respectively; H is the symbol of a hydrogen atom, O of oxygen; N of nitrogen; C of carbon; the indices represent the respective valence numbers; the dash (—) indicates a bond between two atoms, each atom contributing one valence unit.



Formulas like the above are intended to represent the detailed molecular *structure* or *constitution* of substances, and the knowledge of structure is prerequisite to any attempt at making the substance in the laboratory. The problem of determining the molecular constitution of substances is more difficult, because while some elements possess a fixed and unchanging valence, the valence of many other elements varies within narrow limits, being influenced by many factors. Silver is always univalent, aluminum trivalent, silicon quadrivalent, while lead can act either as bivalent or quadrivalent; arsenic either trivalent or pentavalent, etc.

Carbon, of all the elements, gives rise to the largest number and the most complex derivatives (the organic compounds), some of these containing several hundred or thousand atoms of carbon and hydrogen to the molecule. Fortunately, the unraveling of their constitution has been much facilitated by the fact that carbon was found to act so invariably as quadrivalent, that within a few years after the introduction (1860) of the valence theory chemists ceased to look for exceptions. Consequently, the announcement (M. Gomberg, 1900) that a substance was discovered which seemed to offer just such an exception, became a source of much dispute, but the exceptional nature of that substance became finally recognized. The name of that compound is triphenylmethyl, its formula is $(C_6H_5)_3C^{\cdot}$, in which one of the 19 carbon atoms is *trivalent*. It is the first example of an uncompleted molecule; the fragmentary part, the radical, remains in the *free state*, in distinction from the usual behavior of radicals, to pair up, in order to complete the molecule. A completed molecule in this case would be $(C_6H_5)_3C^+-C(C_6H_5)_3$. As a matter of fact, to the extent of about 75%, such is the case in this instance, but these heavier molecules have the tendency to break again spontaneously into the free radicals.

Since the discovery of triphenylmethyl many other free radicals have been prepared wherein an atom of carbon—or of oxygen, nitrogen, lead, tin, etc.—functions in what used to be considered an anomalous state of valence. The establishment of the fact that free radicals can actually exist as such, has proved of assistance in interpreting the mechanism of many chemical reactions, and has been a factor in the renewed study of the whole valence question.

The free radicals as a class are characterized by unusual chemical reactivity. They are *unsaturated* compounds and therefore readily combine with a great variety of substances. Consequently, the preparation of, and the experimentation with free radicals demands a special technique. To the non-observance of these special precautions is to be ascribed the fact that the actual existence of these part-molecules, free radicals, was overlooked for almost 50 years. M. Go.

RADIOACTIVITY, the general term applied to a set of properties and phenomena shown by a number of related substances and consisting chiefly in the spontaneous generation of radiation of a special kind. The first indications of its existence were obtained by

Bequerel in 1896, but through the discovery of RADIUM by P. and Marie Curie in 1898, and the researches of Rutherford and Soddy, radioactive phenomena have reached a place of paramount importance in modern physics, and their study has given great insight into the structure of the ATOM, and the meaning of chemical elements.

The present state of scientific theories may be summarized as follows: It appears that some of the heavier elements, notably uranium, thorium, actinium and radium, all with atomic weights well in excess of 200, contain a nucleus of such complex structure that it is unstable and disintegrates spontaneously, giving rise to three typical forms of radiation, denoted as α -, β -, and γ -rays. The α -rays consist of material particles, viz., positively charged HELIUM atoms, issuing with velocities of the order of 10,000 miles per second, and able to travel from 1 to 4 inches in air before their force is spent. They are stopped by a sheet of paper, and their actual speed, as well as their power of penetration, varies from substance to substance. The β -rays are negatively charged electrons, emitted with tremendous velocities, ranging up to 0.9 that of light, and capable of penetrating through a few millimeters of aluminum. Both α - and β -rays, being streams of electrically charged particles, virtually constitute an electric current, and are deflected from their path by a magnet which provides a method of analyzing their properties. The γ -rays, which nearly always accompany β -rays, are probably caused by the action of the latter upon the electrons revolving immediately around the nucleus. These γ -rays constitute pure radiation, are extremely penetrating, very "hard" X-RAYS, but unlike the α - and β -rays, they are not deflected by magnetic forces.

The process of emitting these three types of radiation is continuous as well as spontaneous, and cannot be influenced by any chemical or physical means now at our disposal; it appears to be an inherent property of the atomic nucleus. An important quantity in radioactive transformation is the *time-period*, that is the interval of time required by any substance to disintegrate by half its amount, and which thus affords a measure for the speed of decomposition. It may vary from only a small fraction of a second—for actinium A—to an estimated time of 20,000 million years for thorium.

At present, three series of radioactive substances are recognized: the uranium-radium, the thorium, and the actinium series, though it is probable that the last is merely a branch of the uranium series. The short-lived intermediate products in these series are known as *emanations* or radioactive gases, while those with a time-period longer than a year have been given names. In all three series the final product is lead, but, although the chemical properties of uranium-lead and thorium-lead are identical with those of ordinary lead, the atomic weights differ, being 206, 208, and 207 respectively; they are all ISOTOPES.

Since the speed of disintegration is held to be invariable for all time, and since its present value can

be determined with fair accuracy for nearly all radioactive substances, the amount of lead present in uranium and thorium ores allows us to calculate the age of these minerals, and thus also to form an idea concerning the age of the earth. W. J. L.

RADIO BEACONS, DIRECTION FINDERS.

Radio beacons may be classified roughly into three groups: those that broadcast in all directions simultaneously; those that radiate in one, two, or more, fixed directions; and those that radiate in a vertical rotating plane.

The first named beacons radiate some characteristic signal, and may be used with a directional RADIO RECEIVER, one using a loop ANTENNA. If the receiver can be used on two or more beacons, the position of the listener can be determined by triangulation, provided the positions of the beacons are known. The same method could be applied to any two radio signals whose identity and station position were known.

The second type of beacon is used extensively by aircraft where the operation of directional receivers is difficult. Characteristic signals are sent in each of two vertical planes. A receiver located on the bisector of the angle between the planes should receive the two signals with equal intensities. Deviation from the path of the bisector will cause an increase in the signal approached and a decrease in the other. Visual instruments may be used to indicate the relative position of the airplane with respect to the predetermined air line. This type of signal is of little use in aiding a lost plane to determine its position, but has great value in preventing a plane flying an established route from becoming lost.

The third type of beacon radiates characteristic signals as it revolves. The listener must be equipped with special devices for determining his direction with respect to the beacon. L. G. H.

RADIO COMMUNICATION. Radio is a term applied to all forms of communication by ELECTROMAGNETIC WAVES, including wireless telegraphy, wireless telephony, and the more recently developed radio broadcasting. The principles of operation and the physical apparatus used in all wireless communication is, generally speaking, the same, although a different modification of the same type of apparatus is used for each. Wireless telegraphy, which is effected by simple signals of dots and dashes, requires the less elaborate equipment and is the simplest form of wireless communication. Wireless telephony, in which speech is transmitted, is more complicated, since the signals being transmitted and received must be made to correspond in magnitude and FREQUENCY to the SOUND vibrations of the voice. But radio broadcasting, in which all forms of speech and musical notes are transmitted, deals with bands of frequency varying from 20 to 10,000 cycles per sec., approximately five times the frequency range required for wireless telephony. Consequently, radio broadcasting is much more difficult to properly transmit and receive than wireless telephone messages.

In all wireless communication, the signals, whether

they be those of a telegraph key, the voice, or of musical instruments, are converted into electrical impulses which are, in turn, converted into electromagnetic waves which are carried through the air over the surface of the earth. The electrical impulses are set up in the same manner as in telegraphy and telephony by wire and are superimposed upon high-frequency impulses or oscillations produced in the RADIO TRANSMITTER circuit. These high-frequency oscillations set up RADIO FREQUENCY waves known as "carrier" waves which are modulated (*see* MODULATION) by the superposition of the low-frequency, or AUDIO FREQUENCY, current. It is these modulations that ultimately produce the audible frequency currents in the RADIO RECEIVER.

Oscillations may be produced in the radio transmitter by three different methods: the spark, arc and vacuum tube. In both the arc and spark oscillators, the oscillations of the current are produced by the intermittent discharge of current across a gap between electrodes. Neither of these are capable of attaining the high frequencies required in modern radio broadcasting, and, for this purpose, the vacuum tube os-

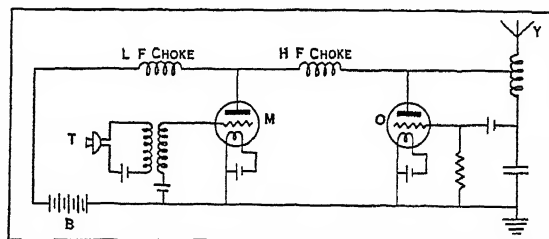


FIG. 1. RADIO TRANSMITTER WITH HEISING MODULATOR CIRCUIT

illator (*see* OSCILLATOR, ELECTRIC) is used. Fig. 1 shows the Heising modulator circuit used in wireless transmission. The oscillator tube, O, sets up high-frequency oscillations which are modulated by the tube, M. The output of M is proportional to the potential on its GRID, and this potential is varied according to the current impulses set up by the telephone, T. The oscillations travel along the ANTENNA, Y, and electromagnetic waves are produced. The waves induce currents in the antenna of a receiving set. These induced currents are then detected (*see* DETECTOR) by the apparatus in the receiver when it is tuned to their frequency and are rectified into currents of audible frequencies which operate a telephone receiver or LOUD SPEAKER (*see* TUNED CIRCUIT).

The currents induced in the receiving circuit may be directly rectified to currents of audible frequency and then amplified (*see* AMPLIFICATION) to produce an output large enough to operate the receiver or loud speaker. However, the modern practice is to amplify the induced radio frequency current, rectify it into audible frequency and then amplify the audio impulses. With the latter system, the rectifier operates on relatively strong current and is much more efficient than in the former case. It also has the advantage of permitting a greater total amplification and, hence, greater volume in reception. For simplicity, a three

RADIO COMMUNICATION



1, 3, 4, COURTESY NATIONAL BROADCASTING CO.; 2, COLUMBIA BROADCASTING SYSTEM

A GROUP OF RADIO PERFORMERS

1. Floyd Gibbons, war correspondent, one of several speakers broadcasting news summaries. 2. Characters in the "March of Time" program in which figures prominent in

the news are dramatized. 3. Phil Cook broadcasting a song and ukelele program. 4. Virginia Gardiner, performer in numerous popular radio playlets.

RADIO DRAMA



COURTESY NATIONAL BROADCASTING CO.

RADIO PLAYS ENACTED BEFORE THE MICROPHONE

1. Radio cast of *Real Folks*. As the characters are called upon to deliver their lines they move before the microphone.
2. Characters in the radio cast of *Beau Brummel* speaking their lines into the microphone.

RADIO DRAMA



PERSONAGES OF LEADING RADIO PROGRAMS

1. John B. Kennedy, Director of Collier's Radio Hour. 2. Cast of a Collier Radio Hour program.
3. Cast of a National Broadcasting Company's Radio Guild drama. 4. Graham McNamee, a leading radio announcer, and Grantland Rice, sports editor and commentator.

stage receiver comprising a detector or rectifier and two stages of audio amplification is shown in Fig. 2. The most practical sets, however, comprise about seven stages, three stages of radio-frequency ampli-

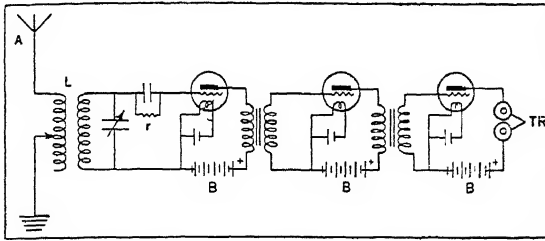


FIG. 2. WIRING DIAGRAM FOR SIMPLE RECEIVER WITH DETECTOR AND TWO-STAGE A F. AMPLIFIER

cation, a detector, and three stages of audio-frequency amplification. Sets are sometimes built with more stages than this but are usually not practical for general use, in that the INTERFERENCE reaches a point where further amplification only serves to intensify it. The circuits employing radio amplification, rectification or detection, and audio amplification are known as SUPERSONIC heterodyne circuits. In this type, SCREEN GRID TUBES, designed to eliminate oscillation within the tubes and the set itself, are generally used in the radio-frequency stages; otherwise, the extra sensitivity produces a howling or squealing in the set.

Many different circuits are used in radio receiving sets, but all operate on the same general principles. In addition to the tubes for detection and amplification CONDENSERS, INDUCTANCE COILS and RESISTANCE units are used to effect the tuning and the filtering out of the radio-frequency currents.

Successful wireless communication dates from the invention of the three-electrode vacuum tube by Dr. Lee De Forest in 1906. During its early life, wireless was limited to wireless telegraphy and wireless telephony, radio broadcasting being a development of the last decade. In 1920, the radio was an idea in the experimental stage with amateurs doing practically all of the communication. By 1930, however, there were more than 600 broadcasting stations in the United States, and the radio industry had reached a value of almost a billion dollars. It was giving work to 300,000 employees and serving about 50 million people.

In this great development, however, radio encountered some serious obstacles. With 600 broadcasting stations in operation it is evident that, unless some means of regulation were provided, interference would render broadcasting impractical. Since the range of frequencies for broadcasting lies between 550 and 1,500 kilocycles, and since each frequency channel must be 10 kilocycles in width to accommodate musical frequencies, there are only 96 channels available in America. Six of these are allotted to Canada leaving 90 for the United States. However, by scheduling the broadcasting time of the different stations and by regulating their power, a system has been worked out whereby all the stations can operate without causing serious interference to the reception from any one

station. Modern developments in transmitting and receiving circuit design have also helped eliminate much of this interference. See also MICROPHONE; RADIO BEACONS AND DIRECTION FINDERS. X.

HISTORY OF RADIO

Although radio broadcasting in the present accepted sense is very recent in origin, the first experiments which led directly to the development of the art of radio communication were performed by HEINRICH HERTZ in 1888. These experiments in the propagation of electromagnetic energy through space were the direct result of theory published by the English physicist, Clerk Maxwell, in 1865.

Something in the nature of electromagnetic radiation was discovered as early as 1842 by JOSEPH HENRY, again in 1875 by THOMAS A. EDISON and after 1880 by David Hughes. The latter discovered something similar to the action of a detector in a type of microphone. However, nothing came of these early experiments.

From 1880 to 1890, Maxwell's mathematical theory was receiving a great deal of attention from three widely separated schools, the German group, centered about HELMHOLTZ, the English group, led by SIR OLIVER LODGE, and the Italian group, headed by Righi. At about the same time that Hertz, from the German group, succeeded in transmitting energy through free space, Sir Oliver Lodge independently succeeded in placing similar radiation on wires and measuring the WAVE-LENGTH of the radiation.

In 1896, GUGLIELMO MARCONI, a pupil of Righi, substituted an antenna of modern type and a GROUND connection for the two plates of the open condenser used by Hertz. The antenna-ground system at once added to the distance covered in the earlier transmission, and was one of the great advances in the development of radio communication.

The next great stride came with the development of arrangements of capacity and inductance for tuning both transmitter and receiver circuits. The first patents on tuned circuits were issued to Sir Oliver Lodge in 1897 and to Marconi in 1900.

During all of the early period of radio development, the transmitters were of the spark-discharge type; a few such stations are still in operation for the transmission of code signals. A large part of the attention of scientists was devoted to improving methods for detecting rather than for transmitting signals.

In Hertz's early experiments, the collector of energy and the detector combined consisted of a piece of wire bent into circular form, with the ends not quite touching. It indicated radio signals only when they were strong enough to cause a spark to jump the gap between the ends of the wire.

The COHERER was perhaps the first reasonably successful detector, but, requiring extremely strong fields, it limited the distance from the transmitter at which signals could be received. A great advance came about when it was discovered by the American physicists, G. W. Pierce and G. W. Pickard, that certain metal

to crystal contacts had different resistance to the flow of electricity depending on the direction of flow. Hence, the CRYSTAL DETECTOR, because of its rectifying action, was able to show average variations in the amplitude of the high-frequency current supplied by the antenna. Audible detection with the aid of head phones was thus rendered practical.

The next great advance in both transmitter and receiver design came about with the development of electronic tubes (*see* TUBES, ELECTRONIC). Since many individuals have contributed to the design of these tubes and of the circuits to be used with them, it is possible to mention here only Fleming, the English physicist, who developed the two-element tube as a RECTIFIER and detector, and Lee De Forest, the American engineer, who added a control grid between the hot cathode and cold plate of the Fleming tube.

Such tubes permit the conversion of direct current to alternating current at frequencies that can easily be controlled. Hence, high-frequency current of constant amplitude for continuous-wave transmission became available. Such radiation in itself is silent in a receiver, as compared to the audible tone resulting from the groups of waves sent out by a spark transmitter. With continuous waves, MODULATION at voice frequencies was possible. Thus the wireless telephone came into being.

Voice and music broadcasting took place sporadically from about 1916 on, but the first pre-announced programs on regular schedule are credited to the Westinghouse Electric and Manufacturing Co., operating station KDKA at East Pittsburgh, Pa. These began on Nov. 2, 1920, with the broadcasting of the Harding-Cox election returns.

The use of electronic tubes as detectors became quite general before, and during, the period of continuous-wave transmitter development. These tubes have entirely replaced all other forms of detectors. They provide the amplification of extremely weak radio signals before detection and also the amplification of audio signals after detection.

Long before the area of modern broadcasting, wireless telegraphy was developed to the point of commercial application, and was in extensive use for ship-to-shore communication and for the transmission of messages across oceans in competition with cable service. Most of these transmitters operated on lower frequencies, longer wavelengths, than those now assigned to broadcasting in the United States. Much more has been done with shorter waves, both long and short waves now being in general use.

Directional radiation as opposed to broadcasting has been developed for use in radio beacons and in point-to-point transmission. Conservation of power and partial secrecy are the advantages of beam radiation.

One of the great triumphs of radio communication has been its application to trans-oceanic telephony. It is possible to pick up the ordinary telephone anywhere and to converse with another person over his own telephone system no matter in what part of the civilized world he may be.

Improvements in the transmission of intelligence between individuals at widely separated points, and dissemination of information and entertainment to large groups of people from both local and foreign sources are the contributions which radio communication offers to society.

L. G. H.

RADIO DRAMA. Drama in its tortuous travels through the centuries has had a way of adapting itself to the physical and mechanical demands put upon it. The size of the stage, the size of the audience, the play being enacted out of doors, or under a roof—the evidence of all these and numerous similar influences can be traced in the dramatic material itself. The introduction of painted scenery and artificial lighting have each in turn been responsible for revolutionary changes in playwriting. Now one finds the drama forced to accommodate itself to a new medium. In an electrical age it must tell its story electrically.

Recent economic trends seem to indicate that the legitimate drama is fated to be confined to the metropolitan areas and that the remainder of the populace will be forced to obtain their drama in some substitute form. (*See* THEATER BUSINESS, LEGITIMATE) Radio is one of the substitutes. If judged by the number of listeners, it is apparently a powerful substitute. In a poll purporting to represent the tastes of a cross-section of the radio audience, drama ranked third among the 18 or 20 various types of entertainment offered over the air.

Everyone recognizes that an audience for a radio play differs from any other audience. It is not a mass audience in a theater. It may number a million listeners, but the million is made up of individuals, or small groups, gathered around countless loudspeakers. Consequently, the carefully planned methods of producing laughter and tears in theatrical audiences fail when practiced on these small groups of people. But because of this very fact, and because the appeal is more personal, it is possible to achieve subtler effects in line readings. Delicate nuances of tone-coloring can be achieved which would be impossible in a theater where the actor must always be conscious of "projecting" the voice so that it may be heard throughout a large auditorium.

The most obvious disadvantage that drama suffers by radio is that it is invisible. A radio audience is to all purposes a blind audience. Gone is all the showy scenery, the elaborate lighting effects, and the pantomime of the actors. In its place radio must rely on a greater appeal to the imagination. The listener has an opportunity to paint his own scenery in his mind's eye—an opportunity indulged in by the audiences of Shakespeare's day, but a forgotten art to the moderns.

Relieved from the artificial and cumbersome mechanics of STAGE SCENERY—a compromise at best—the radio playwright may have as many changes of scene as he chooses, and they can be effected as fast as thought.

Drama by radio demands concentration from the

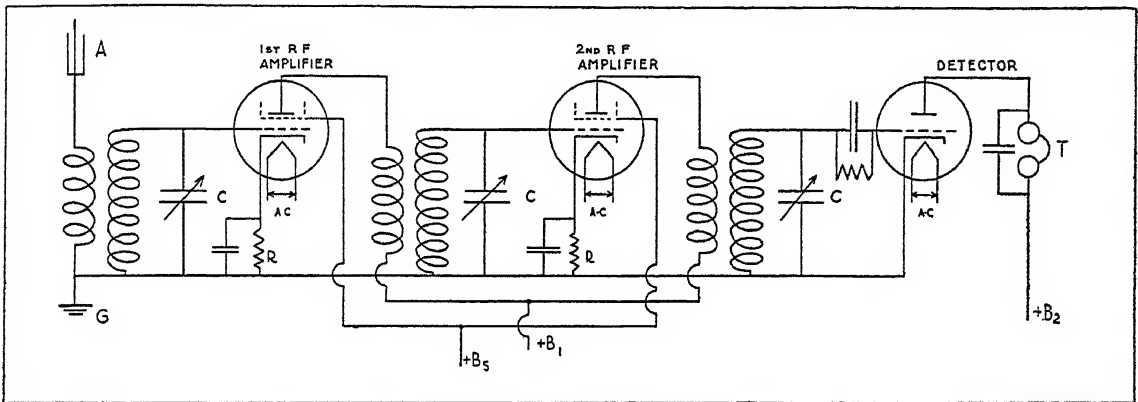
listener. It has found favor, therefore, with those program builders who are interested in developing an attentive audience for this medium, rather than having it used merely as a background to whatever may be going on in the home at the moment.

At present radio has three general types of broadcast plays—adapted stage plays, adapted novels and short stories, and plays written for broadcasting. The greatest success, as might be supposed, has been achieved in the third type. Radio writing has a technique of its own, and adaptations from other mediums have been but partially successful. It has been necessary to make use of this type of material because of the scarcity of good material written especially for radio. One of radio's problems is to attract better writers to it. It is axiomatic that play-writing is difficult. The comparatively few good plays written in a year bear evidence to this. A considerable number of good novels and short stories appear each year, but only a handful of good plays. A good playwright

usually. This is no guarantee that he has radio personality. The great tragedian of the stage may convey only a pompous superiority and empty bombast through the microphone.

Having decided on his cast, the director must realize that the over-emphasis so necessary in every branch of the theater will only result in obvious artificiality in radio.

The theatrical and heavily underlined readings of the average actor, which would pass unnoticed on the stage, being analogous to the broad strokes used in theatrical scene-painting to make it effective, would sound affected in radio. Thus, the director's problem is to achieve readings that escape the inevitable dullness of an actual transcript of life, and that yet avoid a tendency to overstep the bounds of realism. Unless a performance is keyed intimately and sincerely, the effect of eavesdropping on life is lost, and one has only the effect of listening to a rehearsed performance by actors in a studio.



TUNED RADIO FREQUENCY RECEIVER

Employing screen grid tubes in the radio frequency amplifying stages and a three element tube as a detector. Tuning is done by the variable condensers C. The resistors R provide a small biasing potential for the control grids. A is the antenna and G a ground connection. B₁ and B₂ are the plate voltages for the amplifying stages and the detector respectively. B₃ is the potential for the screen grids. Some filters and auxiliary apparatus have been omitted for the sake of simplicity.

is a *rara avis*. A good radio playwright appears to be a *rarissima avis*. He must realize that in radio writing rapidity of action is essential. He must make an asset of the liability of invisibility. He must capitalize the peculiar advantages that radio offers, and capture in his writing that intimacy which is impossible to achieve in any other medium.

Assuming that one has a good piece of radio writing to produce, the director enters the scene. Here is a man who should have a thorough foundation in the theater and also the capacity to forget much of it.

In choosing his actors he must pick them, not for appearance or for the line of parts they might have played in the theater, but according to what their voices sound like. A thin little five-footer might have a Falstaff voice. A forty-year old, two hundred-pounder might sound like a juvenile.

The director must also be sure the voice records well and has personality. Personality is the prime requisite of every actor who steps before the microphone. He may have achieved great heights in the theater pre-

The director must give considerable care to the introduction of whatever sound effects he cares to use to enhance the dramatic effect of the story. Sound effects to a certain extent take the place of scenery. They should never be so obtrusive as to detract attention from the development of the story. Good taste should be exercised in their use.

After a sufficient number of rehearsals, the radio play is broadcast. The reactions of the audience as far as they are ascertainable, are noted. Gradually, through this method of trial and error, a better technique is built.

W. S. R.

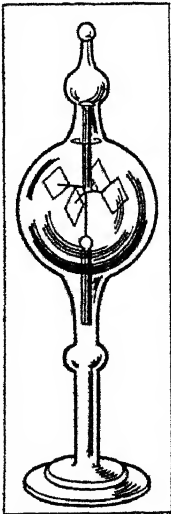
BIBLIOGRAPHY.—Katherine Seymour and J. T. Martin, *How to Write for Radio*, 1931; V. Gielgud, "The Broadcast Play," *Theatre Arts Magazine*, Nov. 1930; "Actors on the Broadcast Play," *Theatre Arts Magazine*, Feb. 1931.

RADIO FREQUENCY, the FREQUENCY of current used for the transmission of electromagnetic energy (see ELECTROMAGNETIC WAVES). Frequencies as low as 20,000 cycles per sec. are commercially used in some wireless TELEGRAPH transmitters. United States

BROADCASTING stations employ frequencies from 500,000 to 1,500,000 cycles per sec. Some amateur and commercial code and phone stations operate at 60,000,000 cycles per sec. and experimental work is in progress at more than 500,000,000 cycles per sec. *See also* RADIO TRANSMITTER.

RADIO FREQUENCY RECEIVER, TUNED, a RADIO RECEIVER in which AMPLIFICATION of the signal is effected at RADIO FREQUENCIES before detection (*see* DETECTOR) and is carried out in an amplifier whose stages are coupled by TUNED CIRCUITS. The circuits may employ simple tuned IMPEDANCE using an air-core induction coil in the plate circuit of each tube (*see* TUBES, ELECTRONIC) with a variable CONDENSER shunted about the coil. More commonly, however, air-core TRANSFORMERS with tuned secondaries are used. When three-element tubes are used in a tuned radio frequency receiver, some form of NEUTRALIZATION is employed to make the set stable. In less well-built receivers, stability may be maintained by a series RESISTOR in the plate circuit of each of the radio-frequency tubes by which the efficiency of the tubes as amplifiers may be controlled; or energy-absorbing devices may be associated with the tuned circuits. With SCREEN-GRID TUBES, no such methods are required for stabilization. The figure on the preceding page shows a schematic wiring diagram of the essential parts of a tuned radio frequency receiver employing two screen-grid tubes as amplifiers and a three-element tube as a detector. L. G. H.

RADIOMETERS. The name radiometer is applied to an instrument—the “light mill” often seen revolving in an optician’s window—designed by SIR WILLIAM CROOKES. Crookes’ radiometer consists of a



W. H. WELCH CO

RADIOMETER

light cross with equal arms, pivoted to revolve in a horizontal plane. Four small, vertical mica plates, blackened on one side, are attached to the ends of the cross, and the whole is enclosed in a glass bulb from which most of the air is exhausted. When placed in a beam of radiation, the cross revolves with the bright faces of the mica turning toward the source. The blackened surfaces are heated more than the bright ones and the rotation is due to the reaction between the residual gas, the walls of the bulb and the unequally heated mica surfaces.

The instrument devised by Crookes was improved by E. F. Nichols and made into an instrument of precision. It consisted of two very small vanes of mica blackened on one side and attached to

opposite ends of a very delicate horizontal support which was suspended at its midpoint by a very fine fiber. When radiation from any source fell on the blackened surface of one of the vanes, due to the radiometric action just described in Crookes’ apparatus, a

torque was produced which tended to rotate the system about a vertical axis. The amount of the rotation was a measure of the radiation emitted by the source. W. W. S.

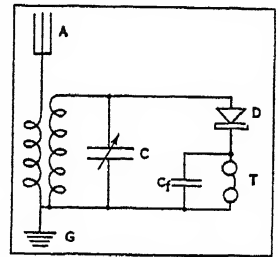
BIBLIOGRAPHY—E. F. Nichols, *Annalen der Physik und Chemie*, 60, p. 401, 1897.

RADIO RECEIVER, a device for making intelligible the signals delivered at RADIO FREQUENCIES. When used for wireless purposes, a radio receiver must be equipped with a collecting device, commonly called an ANTENNA, for absorbing energy from the ELECTROMAGNETIC WAVES and converting it into ALTERNATING CURRENT.

The only absolute essentials of the receiver are a rectifying device (a DETECTOR) and a device for converting the rectified currents into mechanical motions for visual observation or into sounds for acoustical reception.

In addition, it is highly desirable to have INDUCTANCE and CAPACITY which can be adjusted so that a signal of one frequency may be received more efficiently than one of another frequency. This is the element of tuning.

The accompanying figure shows schematically a simple, basic type of radio receiver. Tuning is accomplished by means of the variable CONDENSER, C. An electronic tube or other type of detector may be substituted for the crystal detector, D. A is the antenna, G is a ground connection, T is a pair of telephone receivers and C_f is a small fixed condenser.



The AUDIO-FREQUENCY currents delivered by the detector may be amplified by tubes (*see* TUBES, ELECTRONIC) and proper circuits, so that sufficient energy may be controlled for the operation of a LOUD SPEAKER.

BASIC RADIO RECEIVER CIRCUIT Showing inductance coils connected to (A) the antenna, (G) ground, (C) a variable condenser for tuning the circuit to the desired signal, (D) a crystal detector, (C_f) a small fixed condenser and (T) telephone receivers

The radio-frequency currents of the antenna circuit may be amplified through a number of stages before a detector is used. Additional tuned circuits may be used in this case, simultaneously increasing the sensitivity of the received. *See also* SUPERHETERODYNE; NEUTRODYNE; TUNED RADIO FREQUENCY RECEIVER; RADIO TRANSMITTER; RADIO COMMUNICATION. L. G. H.

RADIO TRANSMITTER, the apparatus which supplies power at RADIO FREQUENCIES to an ANTENNA. It is associated with a MICROPHONE in BROADCASTING. Radiophone transmitters ordinarily employ a MASTER OSCILLATOR, which is usually crystal-controlled, amplifier stages, a modulator stage and a power stage. Older types may employ a power tube (*see* TUBES, ELECTRONIC) arranged for self-oscillations, modulation taking place in the same tube. Similar circuits arranged for keying are used in code stations.

Earlier forms of code transmitters depended on the oscillatory discharge of a CONDENSER system across a

spark gap (see SPARK TRANSMITTER). See also RADIO COMMUNICATION. L. G. H.

RADIO TUBES. See TUBES, ELECTRONIC.

RADISH, the name given to various annual and biennial herbs of the mustard family grown as vegetables. These are regarded as forms of one species (*Raphanus sativus*) thought to have been derived from the weedy radish (*R. Raphanistrum*) native to northern Asia and Europe. Spring, summer and winter varieties with thick edible roots are the forms most commonly grown. The rat-tailed radish (*R. sativus* var. *caudatus*), grown for its long seed pods which are eaten raw or pickled, is rarely seen in American gardens. This is true also of several other varieties popular in China and Japan. Radishes vary in color from white to red, and from one inch globular to six inches elongated. Winter radishes also include black and brown varieties which are often 2 in. and 8 in. long. Summer and winter varieties are far less popular in America than spring kinds, mainly because they require longer time to mature and because the former become strong flavored during hot weather. Spring radishes, being of quick growth and so hardy that seed sown in earliest spring will give edible roots in three or four weeks, are among the most popular of vegetables. M. G. K.

RADISSON AND GROSEILLIERS, EXPLORATIONS OF. Pierre Esprit Radisson, born in 1636 and his brother-in-law Medard Chouat, the Sieur des Groseilliers, born in 1625, were the first explorers of the greater part of Lake Superior and the regions adjacent; the first Frenchmen to visit a number of Northwestern tribes, including the Sioux, Cree, and Assiniboine; and the first Europeans to reach James Bay from the Great Lakes. They were probably the two Frenchmen who spent 1654-56 in the Northwest, returning to Three Rivers with 50 fur-laden canoes, thus revivifying the fur trade of New France. They traded in the interior, 1656-57, and on their return headed an expedition of 31 Frenchmen and 14 natives to induce the Northwestern tribes to go to Three Rivers in large numbers. On the Ottawa River the party was ambushed by the Iroquois, and only Radisson and Groseilliers continued with the Indians. At Sault Ste. Marie they persuaded the Ottawa tribe to make peace with the Pottawatami, and wintered with the Pottawatami at Green Bay. In the spring, 1658, they proceeded westward to "the great river that divides itself in two"—most likely the Mississippi, which they were the first Europeans to see since De Soto. They wintered, 1659-60, among the Sioux of the upper Mississippi, and attempted to cement an alliance of the Northwestern tribes against the Iroquois. In the summer of 1660, they reopened the Nipissing-Ottawa canoe route to Montreal, leading 60 fur-laden boats with 300 warriors. In 1661, returning to the wilderness clandestinely because Governor d'Avaugour was demanding half the profits, they wintered at Chequamegon Bay, Lake Superior, and returned in 1662 with a huge cargo. Their profits greatly reduced by exactions of the governor and the

French monopoly, they allied themselves with the English; their recommendations led to the creation of the HUDSON'S BAY COMPANY and the diversion of much of the northern traffic in peltries from French routes to Hudson Strait.

RADIUM, a chemical element (symbol Ra, atomic weight 226), and the one that most strikingly exhibits the phenomenon of radioactivity, discovered by P. Curie and his wife, Marie Curie, in 1898. Its chemical properties show it to belong to the group of the alkaline earths comprising calcium, strontium, and barium. It so much resembles barium that, in its production from the uranium ores, pitchblende or carnotite, radium remains with barium until the end, the method of their separation from all other substances being based upon the extreme degree of insolubility of their sulphates and carbonates. The ultimate separation of radium from barium, being impossible by chemical methods alone, is then effected by fractional crystallization of their bromides, three or four successive operations being generally sufficient. In the pure state, radium appears as a white metal which melts at about 700° C. and reacts violently with water, displacing hydrogen and forming radium hydroxide.

Radium is one of the most characteristic substances in the radioactive uranium-lead series, and, according to the theory of RADIOACTIVITY, it is formed by the successive disintegration of uranium. Since the rate of this disintegration is constant, all uranium ores, provided they have been in existence for a sufficiently long time, must contain uranium and radium in a definite proportion which is found in practice to be about 3 million to 1. Impure uranium ores containing as little as 1 gram in 20 tons of ore are still considered workable, but as a result, the cost of producing radium is enormous, its present price ranging around \$100,000 per gram.

Radium itself disintegrates slowly into radium emanation, or RADON, while emitting α -rays, consisting of charged helium atoms, the rate of this disintegration being such that about half the available substance is transformed in 1,580 years, while one gram of radium emits approximately 37,000 million charged particles every second. Radon disintegrates again, and after producing in succession a number of other radioactive substances most of which are short-lived, is ultimately transformed into lead. As a result of this continuous activity, radium salts glow with a soft light in the dark, and are always slightly warmer than their environment, one gram of radium, together with all its subsequent by-products, emitting some 1,250,000 calories per year. W. J. L.

The activity of radium is measured in terms of units. These include milligrams and thousandths of milligrams which are known as micrograms. Emanation is measured in curies, milligrams and micrograms, named after the discoverer of radium, Madame Curie. The curie is the amount of emanation present when one gram of radium element is in equilibrium with its disintegration products. The third type

of unit is the mache unit. It is generally considered that 2,700 mache units expresses the equivalent of one microcurie of radium emanation. The term radon is also applied to radium emanation.

Radium is used in the treatment of disease. It has been offered in the form of radium emanation, radium element, radium inhalations, and radium drinking water. The evidence thus far available indicates the usefulness of radium in the control of new growths or cancer. Apparently it inhibits the growth of the cell.

There is no basis for the use of radium or radon in such conditions as anemia, constipation, glycosuria, impotency, glandular rejuvenation or rejuvenation in general. Neither is its use established as of value in rheumatism, heart disease, neuritis, or arthritis.

There seems to be good evidence that radium exposures can affect the activity of the spleen and the lymph glands. They have also been used to stop bleeding from the uterus and for their effects on some skin diseases.

The chief value of preparations of radium today would seem to be in association with surgical measures for the control of cancer, particularly of the female organs, and for the prevention of secondary growths after surgical removal of cancer of the breast and of the prostate. M. F.

RADOM, a city of the Polish voievodship of Kielce on the Radomka River, 75 mi. south of Warsaw. The town existed in the Middle Ages and possessed a royal castle, the remains of which were turned into a priest's house. The common railway management of the three voievodships of Kielce, Lublin and Volhynia has its chief office in Radom. The chief manufactures are leather, agricultural implements and earthenware. Pop. 1931, 78,072.

RADON, a chemical element (symbol Rn, atomic weight 222), belonging to the group of the RARE GASES, and a disintegration product of RADIUM, whence it is also known as radium emanation; formerly also known as NITON. It is a colorless odorless gas, which at about -70°C ., is transformed into a heavy liquid. It is strongly radioactive, and disintegrates quickly, being decomposed to half its amount in 3.8 days.

RAEBURN, SIR HENRY (1756-1823), Scottish painter, was born at Stockbridge, Edinburgh, Mar. 4, 1756. In youth he worked for a goldsmith, from whom he learned miniature painting. He taught himself the rudiments of oil painting and after a pilgrimage to Rome settled in Edinburgh. Raeburn executed strong, virile portraits of the Scottish notables of his day. His specialty was male portraiture, in which he excelled all his contemporaries except Sir Joshua Reynolds. He is known for his trenchant brush work and vigorous flesh tones. Among his finest works are a *Self-portrait* and the portraits of *Lord Newton* and *Dr. Alexander Adam* in the National Gallery of Scotland. Raeburn died at Edinburgh, July 8, 1823.

RAETIAN, a group of some 20 ROMANCE dialects spoken in the Engadine Valley and the Canton of

Grisons in Switzerland by 40,000 inhabitants, and south and southeast toward Frioul by 500,000, first appearing as a literary language in the 16th century with translations of the Bible. It is characterized by the dropping of all final Latin vowels except *a*, by the palatalization of *c* before *a*, and by the retention of Latin final *s* to indicate the nominative singular in masculine adjectives.

BIBLIOGRAPHY—T. Gartner, *Handbuch der ratoromanischen Sprache und Literatur*, 1910.

RAFF, JOSEPH JOACHIM (1822-82), German music composer, was born at Lachen, May 27, 1822. His music education was almost entirely without formal instruction, and his early life was beset by financial hardships. He had the fortune, however, to win the interest of MENDELSSOHN in 1843, and in 1850 became associated with LISZT as a champion of the neo-Romantic movement in Germany. In 1877 he was appointed director of the Frankfort Conservatory, where he served until his death from apoplexy. A fertile composer and an able craftsman, he produced eleven symphonies, several concert overtures, two violin concertos, a substantial body of chamber music, numerous pianoforte works including a concerto, and several operas, among them *König Alfred*. He died at Frankfort, June 25, 1882.

RAFFLESIA, a genus of peculiar East Indian plants parasitic upon vines of the grape family. There are about ten species in Malaya and the Philippines. Their vegetative parts consist of a network of cellular threads branching in the tissues of the host plant. The flower, sometimes of colossal size, springs directly from the vine on which the parasite grows. *Rafflesia Arnoldi* of Sumatra, the first species discovered (1818), bears a huge flower, sometimes 3 ft. across and weighing 15 lbs., and *R. Schadenbergii* of the Philippines is an even larger form. The mottled, flesh colored flowers, exhaling the odor of putrid meat, are visited by carrion flies. It is believed that these insects, by bearing pollen to the female flowers, effect fertilization.

RAGGED ROBIN (*Lychnis Flos-cuculi*), a slender perennial herb of the pink family, known also as cuckoo-flower, commonly grown in gardens. It is a native of Europe and northern Asia, naturalized in North America from New Brunswick to Pennsylvania. The branching stems, 1 to 2 ft. high, downy-hairy below and somewhat viscid above, bear narrow lance-shaped leaves and profuse clusters of red or pinkish flowers with their petals divided into linear segments.

RAGGED SCHOOLS, religious reform schools instituted in England by John Pounds (1766-1839) for the moral and intellectual instruction of children whose wretched condition excluded them from the usual educational establishments. At first Sunday Schools, the ragged schools developed into day schools, of which St. Giles (1844) was the first. Charles Dickens in his column in the *Daily News* did much to arouse the attention of the public to the benefits of these schools. The ragged schools spread rapidly and are now prevalent in England, Scotland and Wales.

RAGNARÖK, in Scandinavian mythology, the judgment day of the gods, when the **ÆSIR** fight the powers of Hel, led by Loki. It is also interpreted as "the twilight of the gods." Wagner makes it the theme of his Ring.

RAG PULP. See **PAPER**.

RAGUSA, a town in southern Sicily, the capital of the province of the same name, situated about 32 mi. from the city of Syracuse. It is famed for its churches of Gothic architecture, and is commercially important for its quarries and its production of oil. Pop. 1931, 50,193.

RAGUSA, Serbo-Croatian Dubrovnik, a Yugoslav city in Dalmatia on a peninsula at the foot of the Srgj Mountain. Its heyday in the 15th Century, when it was "Queen of the Adriatic," rivaling Venice, is attested by splendid buildings, the Rectors' Palace and cathedral, massive encircling walls, towers and bastions. Due to its beautiful situation, sunny climate and subtropical vegetation, it is the favorite Dalmatian tourist resort in winter and summer. Round about grow olive trees and date palms, as in Greece and Sicily. The old Ragusa was settled in the 7th Century by those who fled from Epidaurum, when destroyed by the Slavs. Till 1204 it was a Byzantine city, then autonomous under the protection of Venice until 1358 when it became dependent on Hungary. After 1526 it was free. The flourishing trade decreased after the earthquake of 1667. Captured by the French in 1805 it fell to Austria in 1814 and after the fall of the Hapsburg Monarchy became part of Yugoslavia. Pop. 1931, 18,767.



COURTESY IOWA GEOL. SURV.

COMMON RAGWEED

Flowering branch with upper leaves and flower clusters

RAGWEED, the common name for a genus (*Ambrosia*) of coarse weedy herbs of the composite family. There are about 15 species, natives chiefly of North America, nine of which are found in the

United States. They are rank-smelling, widely branched plants with usually lobed or deeply cut leaves and small inconspicuous heads of greenish flowers appearing in late summer or early autumn. Several species are widespread as weeds, often becoming exceedingly troublesome in cultivated grounds, as the common ragweed (*A. artemisiifolia*), with deeply cut leaves, found from Nova Scotia to British Columbia and southward to Florida, Bermuda and Mexico, and the great ragweed (*A. triloba*), with three-lobed leaves, growing from Quebec to Florida and westward to Manitoba and New Mexico. The pollen of both these species, which is shed in great profusion late in August and carried to considerable distances by the wind, is one of the most prolific causes of hay fever.

RAGWORT, a name given to various annual or perennial herbs of the groundsel genus (*Senecio*) of the composite family. The golden ragwort (*S. aureus*) is one of the common wild flowers of eastern North America; the tansy ragwort (*S. Jacobaea*), abundant in Europe, is naturalized from Newfoundland to Ontario; the purple ragwort (*S. elegans*), native to South Africa, is widely grown in gardens.

RAHWAY, a city of Union Co., N.J., located on the Rahway River and on the Pennsylvania Railroad, 12 mi. southwest of Newark. It is a suburban residential community, a trading center and has a number of important manufacturing establishments, among the products of which are chemicals, pharmaceuticals, cereals and vacuum cleaners. In 1929 the factory output amounted approximately to \$14,000,000; the retail trade reached a total of \$6,852,741. Settled in about 1720, it derives its name from that of Rahwack, a local Indian chief. It was the scene of fighting during the Revolution and many buildings dating from Colonial times are still standing. Pop. 1920, 11,042; 1930, 16,011.

RAIKES, ROBERT (1735-1811), English publisher and educationalist, was born at Gloucester, England, Sept. 14, 1735. From 1757 to 1802 he published the Gloucester *Journal*. In 1768 he voluntarily went to jail and upon his release was active in calling public attention to prison conditions. In July, 1780, he founded the first Sunday school in Gloucester, originally for the purpose of giving poor children an elementary education. This idea spread rapidly, and before his death on April 5, 1811, Raikes had seen his plan, or a modern adaptation of it, accepted throughout Great Britain.

RAIL, a group (*Rallinae*) of small or medium sized wading birds closely allied to the coots and gallinules. Rails are of world-wide distribution but most abundant in the tropics. They have slender bodies, rather long necks, short rounded wings, long stout legs and feet, and loose, mostly dark plumage. Frequenting grassy marshes, often in large numbers, they feed upon worms, crustaceans, insects and aquatic plants, nesting usually on the ground and laying 6 to 15 buffish-white, variously speckled eggs. Although performing extensive migrations, rails are weak flyers and depend for

safety upon running and hiding. When fat the flesh of many species is highly esteemed for the table.

Of some 15 species and varieties found in the United States, the best known are the sora or Carolina rail (*Porzana carolina*) and the Virginia rail (*Rallus limicola*), found across the continent; the king rail (*R. elegans*) and the clapper rail (*R. longirostris*) of the eastern states, and the California clapper rail (*R. obsoletus*) of the Pacific coast.

RAILROAD, or RAILWAY, a transportation agency consisting essentially of a strip of land, or "right-of-way," usually 66 to 100 ft. wide along the center of which a prepared roadbed carries a track or tracks; and additional land at stations (*see* RAILROAD BUILDINGS), yards and terminals with the necessary buildings thereon, together with the equipment and RAILROAD ROLLING STOCK required to carry on the business of transporting passengers, freight, mail and express. It takes its name from the fact that it utilizes RAILS laid upon a road or "way" to facilitate the movement of its cars and locomotives. For brief descriptions of its various components *see* RAILROAD TRACK; RAILROAD MOTIVE POWER; RAILROAD TERMINALS; RAILROAD YARDS. *See also* ELECTRIC RAILWAY.

RAILROAD ACCIDENTS. The high degree of safety of travel on American railroads is attested by the fact that only 100 of the 786,432,468 passengers carried in 1929 were killed and only about 4,000 were injured. Furthermore, only 36 of the fatalities occurred in train accidents, mostly derailments; 37 happened while getting on or off cars and 19 from being struck or run over. The total number of steam railway fatalities for that year was 6,496, of whom 2,307 were trespassers, and only 326 of these fatalities occurred in connection with accidents to trains.

BIBLIOGRAPHY.—Interstate Commerce Commission, *Accident Bulletin—Steam Railways*.

RAILROAD BUILDINGS. Passenger stations or depots, one room of which also often serves for baggage, freight and express in small places, are the most common railroad buildings. Most cities have separate freight houses and the larger ones have at least two, one for in-bound and the other for out-bound freight, and a transfer house for resorting and reloading freight for each road entering the city; though these same roads may combine their passenger and mail facilities and sometimes express facilities in a "union" station. The large freight houses are usually long, low buildings 30 to 40 feet wide, with paved trucking areas on one side and several lines of service tracks on the other. Convenient teaming tracks are also provided for the receipt and delivery of freight, especially carload lots and bulky or heavy articles which can not be handled readily through the freight house. Many shippers are served by branch lines and sidings.

Other buildings exclusively for railroad purposes are largely concentrated at division points, that is, at the terminals; but smaller structures, such as pumping stations, section tool houses, coaling sta-

tions, water stations, and of course signal and interlocking towers are located wherever needed. One building always found at a "yard" is the engine house which is used for the storage and care of locomotives between runs. The "stalls" of an engine house are usually built radial to a circle having the TURNTABLE at its center, and hence the terms engine house and roundhouse are practically synonymous. Engine houses are sometimes rectangular, the separate stalls being served by a transfer table moving laterally in front of the house, or, in case of only a few stalls and plenty of room in front of the house, by a separate branch track to each stall. Engine houses are equipped with tools for making light repairs and with air, steam, and water lines for washing out and refilling boilers, etc. The coaling station consists generally of elevated bins for storing coal, from which it is discharged to hoppers over the tracks on which the locomotives run in passing to or from the engine house. The sand house has facilities for drying the sand and for delivering it to locomotives. The oil house is a fireproof structure used for the storage of oil. Various shops, such as the erecting shop, blacksmith shop, machine shop, paint shop, and the like, are provided according to the requirements at the terminal. Usually there is also a club or a Y.M.C.A. building for the use and convenience of the men. *See also* RAILROAD TERMINALS. F. A. B.

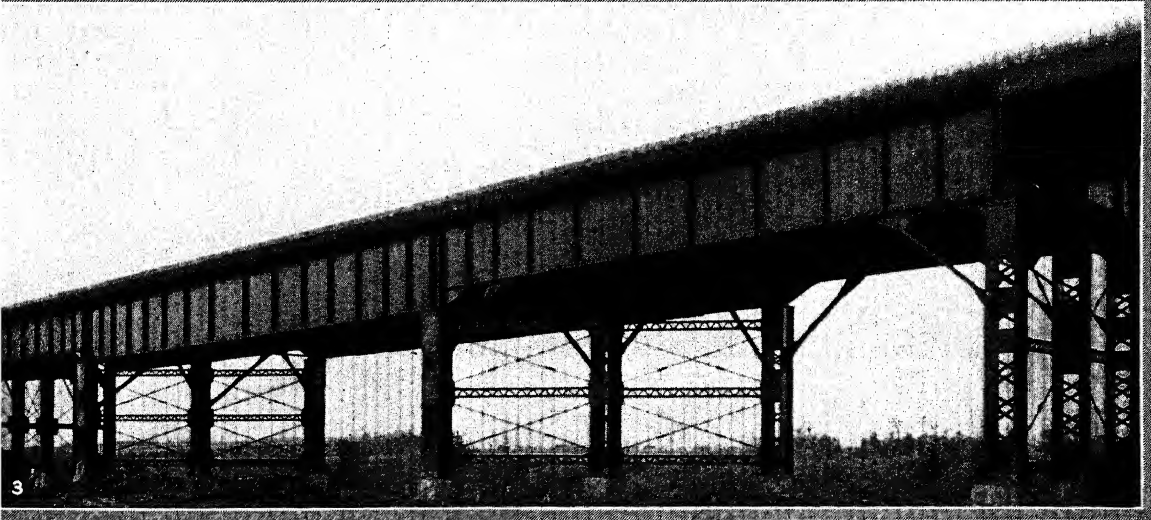
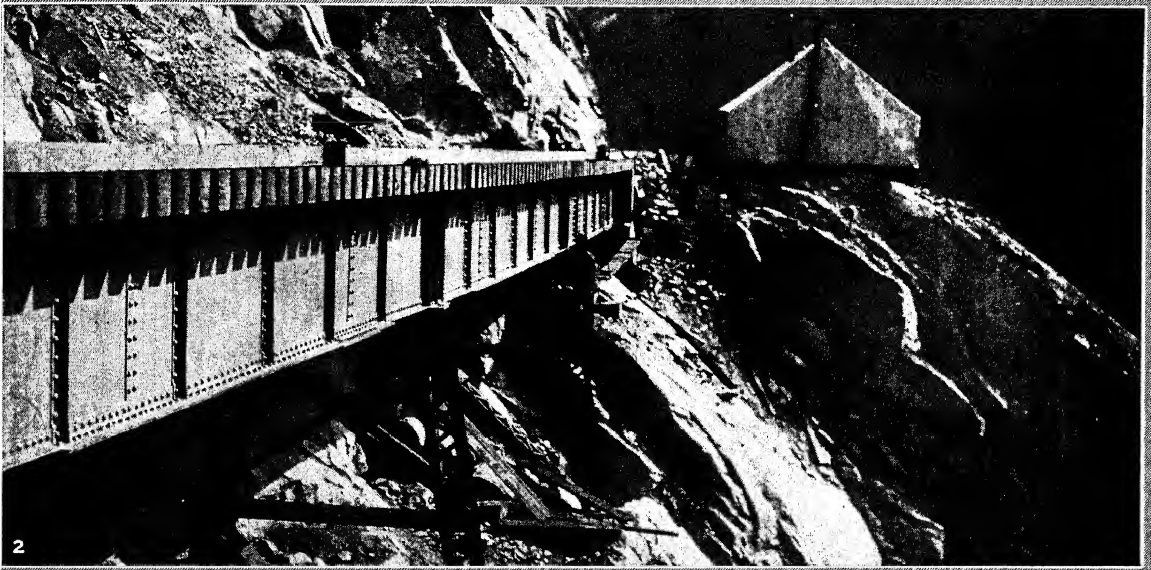
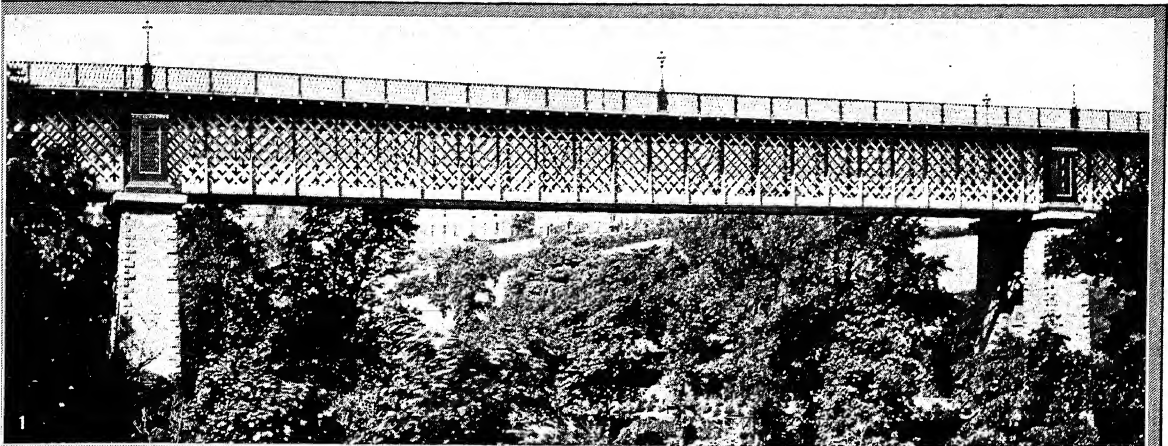
RAILROAD MAINTENANCE, a term covering the work necessary to keep RAILROAD property in good condition. It comprises two separate departments:

Way and Structures, a department charged with the duty of keeping in good and safe condition the roadway, tracks and structures. On some roads it also handles extensive reconstruction and even new construction, while on others a separate engineering department is charged with such work. The major part of ordinary maintenance work consists of keeping the track in safe and easy-riding condition. The safety of the track depends largely on "track-walkers" who watch for broken rails, loose joints, obstructions and the like. Ease of riding depends upon the alignment and level surface of the rails, i.e., upon the work of the "section gang." *See also* RAILROAD TRACK; RAILROAD BUILDINGS.

Equipment. The work of maintaining the rolling stock and other mechanical equipment of a railroad in good condition by making the necessary repairs and replacements is performed by the "mechanical department." Most of this work is done at "division" shops and engine houses under the direction of the master mechanic, but heavy repairs and replacements and sometimes new construction are handled at centrally located shops where proper facilities for performing such work are provided. F. A. B.

RAILROAD MOTIVE POWER. For nearly three centuries horses were used to haul cars on the level stretches of railways, while they were hauled up the steep inclines first by windlasses, and later by stationary engines. Although successful Locomo-

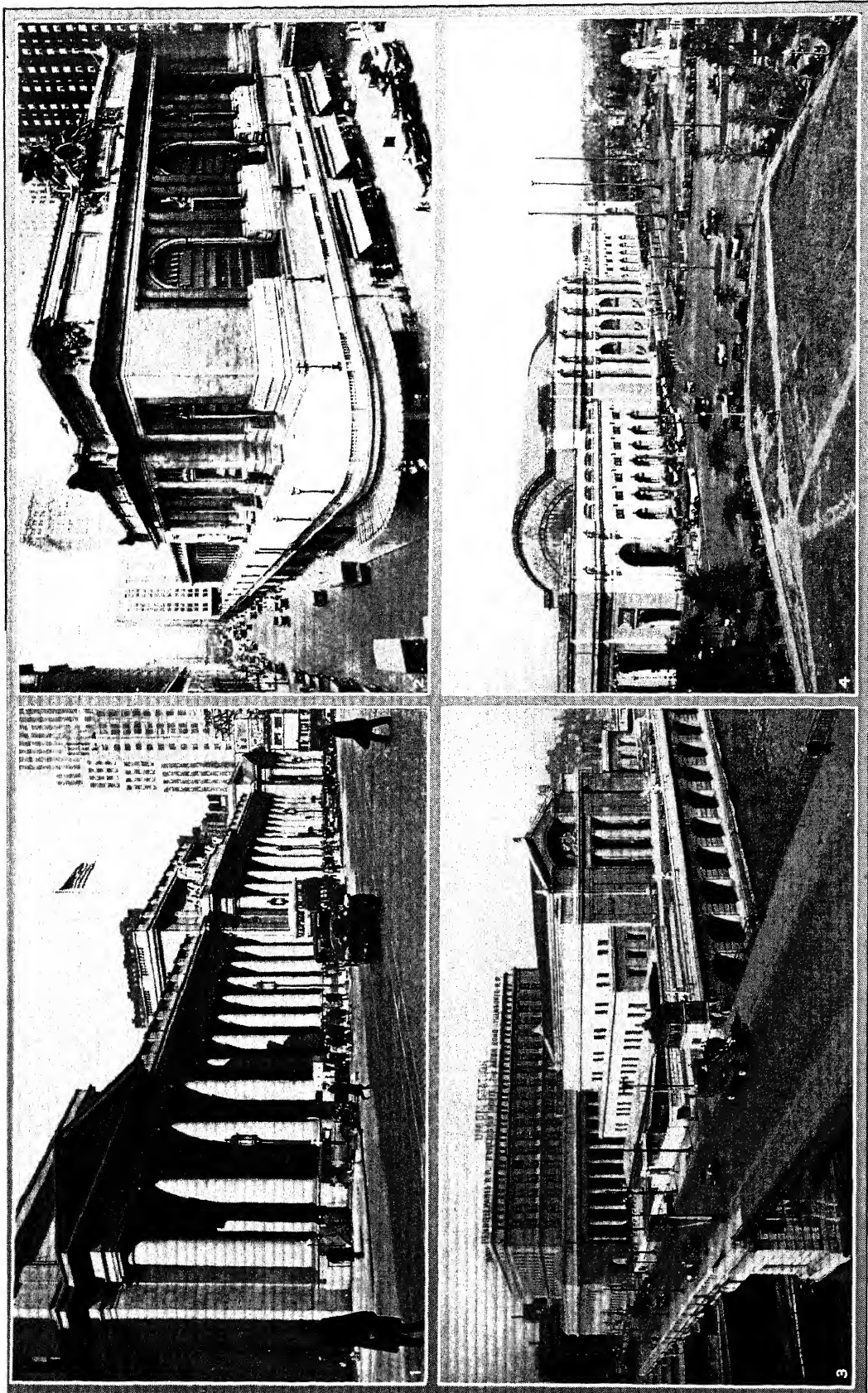
RAILROAD



TYPES OF RAILROAD GIRDERS

1. Lattice girder at Scarborough, England. 2. Plate girder of the White Pass Railroad, Alaska. 3. Double track plate girder of the Duluth, Missabe & Northern Railroad, Duluth, Minnesota.

RAILROAD TERMINALS

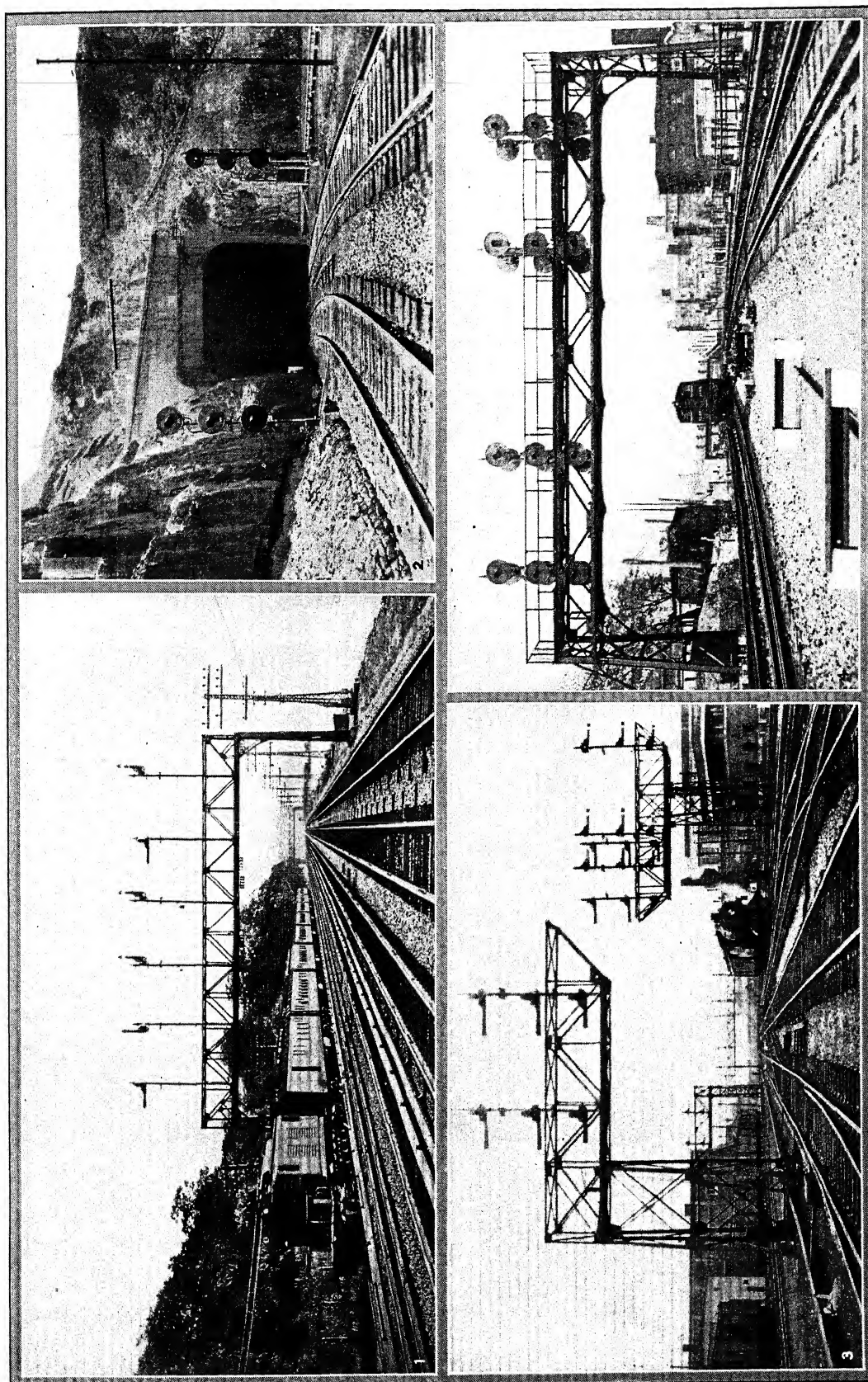


1, 3, 4, R. I. NESMITH AND ASSOCIATES PHOTO; 1, GEORGE A. DOUGLAS PHOTO; 4, CHARLES PHELPS CUSHING PHOTO; 2, COURTESY NEW YORK CENTRAL RAILROAD CO.

RAILROAD TERMINALS OF AMERICAN CITIES

1. Pennsylvania Station, New York, New York.
2. Grand Central Terminal, New York, New York.
3. Union Station, Chicago, Illinois.
4. Union Station and Plaza, Washington, D.C.

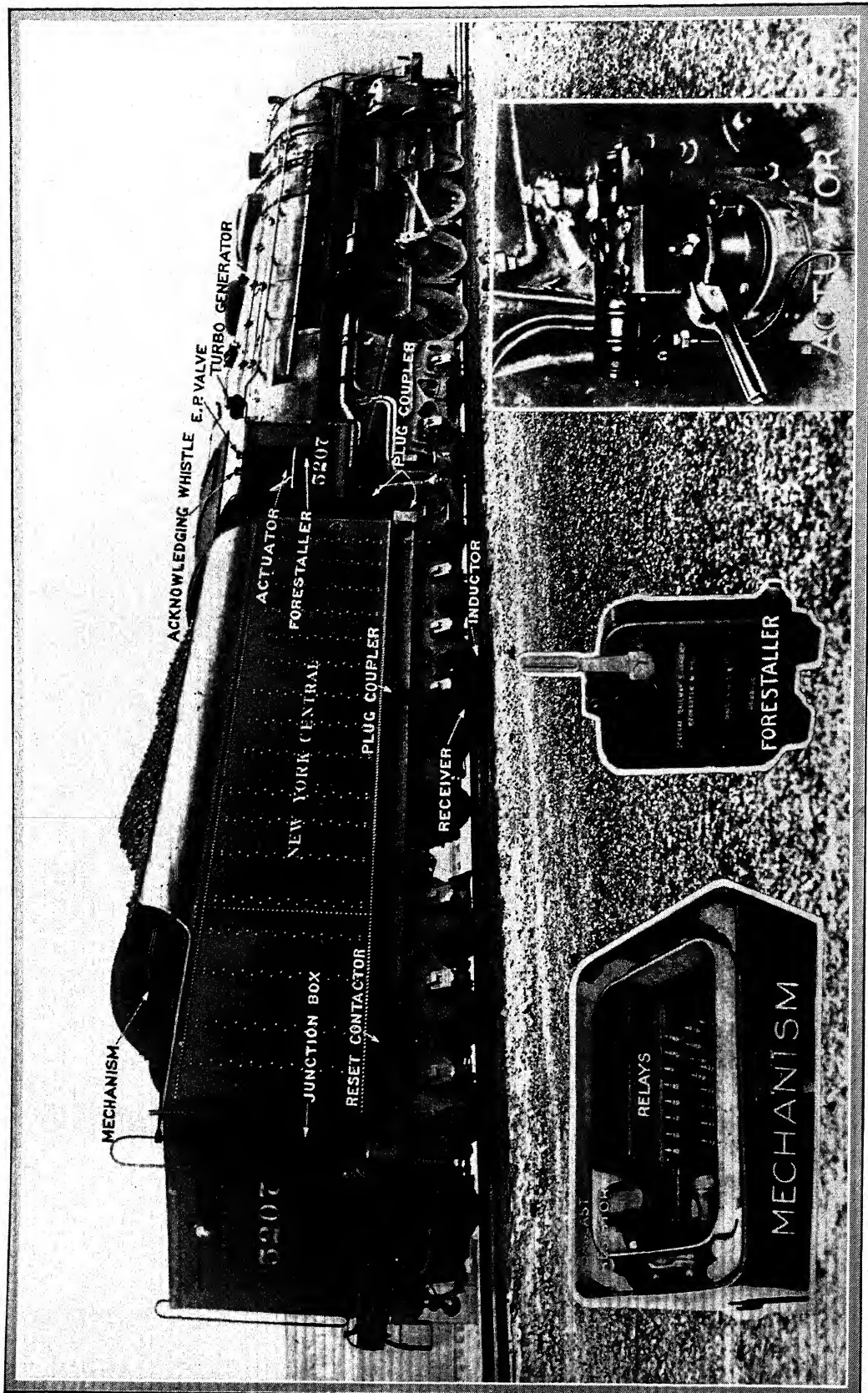
RAILROAD SIGNALING AND INTERLOCKING



RAILROAD SIGNAL INSTALLATIONS

1. Six-track semaphore signal bridge; the first and fifth signals indicate "stop," the others, "proceed."
2. Two units of color signals.
3. Two-track yard semaphore signal bridge at left, four-track signal bridge at right.
4. Four-track color signal bridge.

RAILROAD SIGNALING AND INTERLOCKING



COURTESY NEW YORK CENTRAL LINES

AUTOMATIC TRAIN CONTROL EQUIPMENT

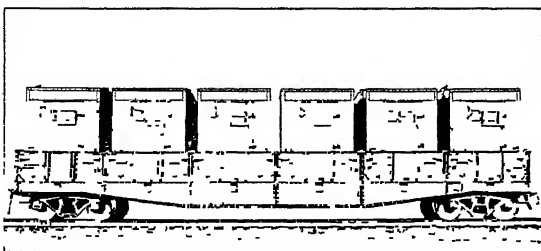
If a caution signal is displayed, in order to avoid brake application the engineer must operate the forestaller lever while the locomotive receiver is passing over the inductor. The acknowledging whistle indicates when the lever may be released. If the engineer fails to operate the forestaller lever, the actuator moves the brake valve, applying the brakes, which can then be released only by operating the reset contactor located on the tender.

tives and automotive wagons were built in both England and America as early as 1804, it was not until 1829 when one of ROBERT STEVENSON'S locomotives, the "Rocket," won a contest on the Liverpool & Manchester Railway, that the steam locomotive really won recognition and became firmly established as the proper motive power for railways. The "Rocket" weighed $4\frac{1}{4}$ tons and had a maximum speed, when running light, of about 30 miles an hour. Except for light switching or for some special purpose, such as logging, few locomotives are now built weighing less than 100 tons, and engines weighing from 150 to 250 tons are quite common.

The substitution of electric power for steam power—the electrification of steam railways—was a much discussed question twenty years ago and some enthusiasts looked for the almost complete substitution of electricity for steam. A few roads did electrify congested districts at that time and the policy of electrifying wherever circumstances make it desirable has been and is still being followed. Discussion of the general electrification of steam railways, however, lost vigor some years ago and more and more lines of comparatively light traffic are being operated as cheaply as possible with oil-electric locomotives (*see DIESEL LOCOMOTIVE*) or gasoline-electric cars. Of the 242,000 miles operated by Class 1 steam railways in the U.S. at the end of the year 1929, only 2,382 miles were operated by electricity. The mileage of track electrically operated was more than double this, or 4,914. Most of these changes were in districts where electricity would have the advantages of increasing track capacity, doing away with smoke nuisance and similar drawbacks to steam operation. F. A. B.

RAILROAD ROLLING STOCK, the equipment of a railway which moves or "rolls" on the track. Most of this consists of the locomotives and cars used in freight and passenger service, but there is also RAILROAD WORK EQUIPMENT. *See also* RAILROAD MOTIVE POWER.

Day coaches constitute a large percentage of the passenger cars but there are also special types such as parlor or chair cars, observation cars, dining cars,



COURTESY, NEW YORK CENTRAL LINES

DROPSIDE MERCHANDISE CONTAINER CAR

Equipped with six containers which can be unloaded from the car as units. The use of container cars in handling bulk products saves much labor and time in unloading cars

sleeping or Pullman cars, though not all owned by the Pullman Company, lounge cars and club cars. There are also combination passenger cars in which part of the space is used for baggage, etc. In con-

nection with passenger trains, or in separate "solid" trains, are postal or mail cars, express cars and milk cars. In freight service in the U.S. are over a million box cars and nearly a million coal cars. Of the remaining 597,000, over 100,000 are flat cars and 89,000 are stock cars; the others consisting of 160,000 tank cars, 152,000 refrigerator cars, CABOOSES, or cabin cars, and other freight train cars. Only 6% of the tank cars and 27% of the refrigerators are owned by the railroads. In company service are pay cars and official cars resembling passenger equipment.

F. A. B.

RAILROADS, ECONOMIC PHASES OF. Railroads are, from one point of view, machines produced by engineering skill, and operated in accordance with physical laws. From another point of view they are aggregations of men, organized to render a service of transportation, who face problems such as are incident to large scale business in any field, except that railroad men have the particular task of shouldering the responsibilities of COMMON CARRIERS.

The following table presents selected statistics which indicate the magnitude of the operations of the railroads of the United States.

SELECTED STATISTICS OF CLASS I RAILROADS OF THE UNITED STATES FOR THE YEAR ENDING DECEMBER 31, 1930

Miles of railroad operated	242,159
Investment (thousands)	\$26,211,017
Operating revenues (thousands)	\$5,281,196
Revenue ton-miles (millions)	383,450
Passenger-miles (millions)	26,815
Number of employees	1,487,730
Compensation of employees (thousands)	2,550,553

The figures just quoted show clearly that railroads are to be classed as a major industry. They are among the great employers of the nation's labor, and they put to use a substantial proportion of the nation's capital. It is, therefore, especially worthy of remark that the railroad system of the United States is passing through a period of transition, and that the final outcome is not yet clear. For this there are several reasons. Like other businesses, railroads have suffered from the acute business depression of 1930-31. They have been, moreover, peculiarly affected by the expanding use of the motor vehicle operated upon the public roads, and they have suffered from the large expenditures which the Federal Government has made upon inland and intercoastal water transportation. It is difficult to say precisely how much freight the improved Mississippi River and the Panama Canal have diverted from the railroads. The carriers assert that their loss from subsidized water competition has been considerable, and they specifically attribute to the popularity of the motor vehicle a decline in their passenger traffic from 47,340 millions of passenger miles in 1920 to 31,165 million passenger miles in 1929, a loss of 34%. It is also possible that the future development of air and pipe line transportation may intensify the effect of automobile and water operation.

The railroads' financial position depends partly upon the rates which they are able to charge. Many railroad rates are controlled by competitive forces, but, in addition, all schedules must be approved by the Interstate Commerce Commission (*see* INTERSTATE COMMERCE ACT) before they are put into effect. Since 1920 the Commission has refused all requests for general increases in railroad tariffs. Railroad solvency depends also somewhat upon the character of the consolidation program which the carriers are invited to put into effect, and on the speed with which this program is carried through. If prosperous railroads throughout the country are required to assume responsibility rapidly for the smaller and weaker members of the group, it is very probable that general railroad credit will decline, although some carriers and some shippers will be benefited. The fundamental problem which the railroads have to solve, however, is not that of government control of their industry, nor even that of the regrouping of their companies, but it is rather the adjustment of the technique of rail transport to the conditions brought about by new forms of carriage.

Railroads have criticized the expenditure of government funds for the construction and operation of a system of inland waterways, and they have opposed the installation of common carrier service upon the roads. Most railroad managements understand, however, that no protest can prevent the substitution of a superior for an inferior machine. The very active controversy now carried on turns, rather, around the railroad charge that motor vehicle truck and bus common carriers do not contribute enough in taxes to cover road expenditures made in their behalf, and that they do not pay a fair amount toward the support of the general government. If they do not, and if the Government barge line upon the Mississippi River fails to pay its way, then the scales are weighted against the railroads, and their relative advantages are obscured. With respect to the Mississippi River, the railroads seem to have proved their point. The case is less clear as to the taxation of motor vehicles, for special taxes have multiplied in recent years, while the almost universal gasoline tax has provided large sums for road maintenance and construction. The general tenor of the testimony of the chief of the United States Bureau of Public Roads is, at least, that trucks damage the roads less than has been supposed and that present taxes are probably adequate to make the damage good.

It is very likely that the railroads of the future will be more transportation companies than carriers relying upon a single technique in the provision of transportation service. Many railroad companies already operate bus lines through subsidiary companies, and contract with trucking firms for terminal operations. A few have coordinated certain of their rail services with the service of air companies. There seems to be no reason why all of this cannot be done successfully, nor why, if it is done, the new transportation companies cannot be maintained.

S. D.

RAILROAD SIDING, an additional track, usually at stations, on which freight cars are placed for loading or unloading; or on which trains are placed to clear the main track.

RAILROAD SIGNALING AND INTERLOCKING. The signal system of a railroad is generally considered to consist of the apparatus and appliances used to convey information or orders to the men who control the movement of trains by means of signals which change in aspect or indication. Hand, lantern and flag signals and fixed signals or signs which do not change aspect, such as whistle posts, are not included in this classification.

Signals which change in aspect commonly give three indications: Stop, Proceed with Caution, and Proceed—though the two-position signal gives only the first and last. These indications are given by either semaphores or lights. The semaphore signal has a board or arm indicating, in the three-position signal, Stop when horizontal, Proceed with Caution when inclined, and Proceed when vertical. Light signals are either: 1. Position, with three white lights giving indications the same as the semaphore; 2. Color, with red, yellow and green giving the three indications, respectively; and 3. Color-position, a combination of the other two. Night indications of semaphore signals are *color*, the "spectacle" or casting holding the blade bringing a lens of the proper color in front of a light for each aspect of the signal. As light signals have no moving parts exposed to the weather they are rapidly replacing semaphore signals.

"Block" signals may be defined as those at the ends of blocks, or sections of track into which only one train is ordinarily admitted at one time, thus maintaining a predetermined distance between trains. On light traffic roads, signals are operated manually and are located at the stations only. The sections of track between adjacent stations are really "blocks," though never so called. With this "manual" system each operator has full control of his signals and acts upon advice received by telephone or bell signals from operators of adjacent stations. With the safer and more common "controlled manual" system each signal is locked electrically in the stop position as soon as a train passes the station and can be unlocked only by the operator at the succeeding station.

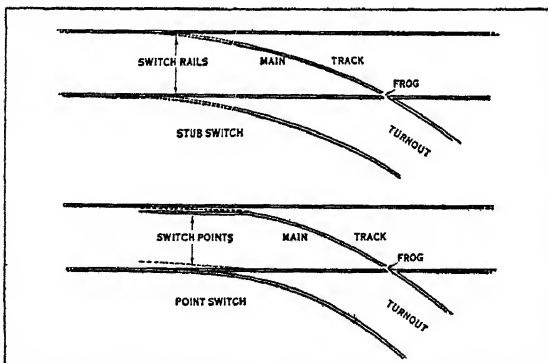
Less "headway" between trains is obtained with heavy traffic by shortening the blocks, i.e., by inserting additional towers between stations or locating a system of towers at short intervals. Due to the large number of operators required the controlled manual system has been largely replaced by the "automatic," in which the signals are operated by the trains through electrical track circuits.

The "staff" system is considerably used in England and to some extent in America for especially dangerous sections of single track such as over a bridge or through a tunnel. Before entering the section the engine man must obtain a small cylinder, or staff, from the staff machine and the two machines at the ends of the section are so interlocked that only one

staff can be out at one time. When used to control successive sections, or blocks, the pairs of machines for each block are different, thus making errors nearly impossible.

Interlocking machines are used to prevent errors where a number of switches and signals are operated from the same tower. The levers operating the switches, signals and derails are so inter-connected that it is impossible to set "proceed" signals for two conflicting routes or even to set a proceed signal at all unless the DERAILS are closed and the switches properly set for the route which it controls. Early interlocking was accomplished mechanically but most of the new machines are electro-pneumatic or entirely electric, and some of the simpler installations are automatic, i.e., operated by means of electric currents through track circuits. The use of electricity for operating valves on compressed air motors or directly for motors operating signals, switches and other devices has made possible also remote control of operations over a considerable district from a central point. Such installations are increasing rapidly. The operator is guided in his work by a track chart or indicator showing continuously the position of all signals, switches and trains in the district.

Automatic train control devices are really extensions of the signal system as they do not come into action unless a signal has been disregarded by the engineman. Such devices, operated by wayside apparatus which actuate, either mechanically or magnetically, proper devices on the locomotive, are in successful use not only for stopping trains but for reducing speed to predetermined limits. Cab signals, actuated by a coded current passing through the rails and giving a continuous indication of the track conditions ahead, are now preferred since the control of the locomotive is not taken from the engineman as it is with automatic control. The attention of the engineman is called to every change in signal indication by a whistle which blows continuously until he "acknowledges" by pressing a lever. Obviously, this system is



RAILROAD SWITCHES

Dotted lines show the switching position of rails

not affected by fogs or storms and "wayside" signals may eventually be dispensed with entirely. F. A. B.

RAILROAD SWITCHES, devices installed in railroad tracks to enable trains or cars to pass from

one track to another—as onto a siding or onto a branch line. A switch or "turnout" consists essentially of three parts—the switch rail, the lead rail, and the Frog switch. In the old *stub* switch, the switch rails were cut off at the forward end and were simply thrown to connect with the main track rails or the lead rails for the turnout as desired. In the *point* switch, now in universal use on account of its greater safety, the throw is at the beginning or point of the switch, the outer main track rail and the inner turnout rail are continuous, one switch rail is in the main track and the other in the turnout

F. A. B.

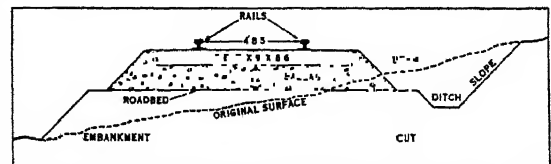
RAILROAD TERMINALS. The American Railway Engineering Association defines a terminal as "an assemblage of facilities provided by a railway at a terminus or at intermediate points on its line for the purpose of receiving, sorting, classifying, assembling and dispatching trains." According to this definition the freight terminal, in addition to the freight houses (see RAILROAD BUILDINGS) and team tracks where freight is actually handled, i.e., received, delivered, transferred or stored, includes the various yards, the engine house and possibly shops, and tracks for various purposes such as storage, icing, and the like. See RAILROAD YARDS.

Similarly passenger terminals include, in addition to the station with its usual facilities for handling passengers, baggage, express and mail; track or yards for the storage of coaches; shops for their repair or repainting; facilities for furnishing ice and other supplies; ash pits; coaling and sanding facilities; and an engine house if the passenger terminal is remote from the freight terminal. Passenger terminals are of two general types: *stub end*, with tracks connected at one end only and *through*, with tracks connected at both ends. There are also a few *loop* stations in which a loop makes provision for turning the trains for the return trip.

F. A. B.

BIBLIOGRAPHY.—J. A. Droegge, *Freight Terminals and Trains*, 1925, and *Passenger Terminals and Trains*, 1916.

RAILROAD TRACK consists of the rails and ties, and their fastenings, such as spikes and joint plates. Tie plates used between the rails and the ties to prevent wear of the latter, rail anchors to prevent its longitudinal movement, rail braces to



CROSS SECTION OF TYPICAL STANDARD GAUGE RAILROAD TRACK

prevent the rail from tipping over on curves, switches and guard rails are also considered part of the track.

Ties are almost universally of wood although many substitutes have been tried, especially when the cost of wood ties increased rapidly. Steel ties of various shapes, and combination ties of steel and concrete

were the most common substitutes, but none has proved satisfactory. Most railroads have turned to the use of ties treated with some preservative (*see* WOOD PRESERVATION) for the purpose of prolonging their life. This treatment also makes it possible to use many of the cheaper woods which could not otherwise be used at all due to their very short life if untreated. About four-fifths of the ties now used in the U.S. each year are treated and their longer life has resulted in an enormous reduction in the number of ties required annually for replacement.

The "rail" from which the railroad or railway gets its name has developed from the timbers laid as runways for coal carts at the collieries at New Castle on Tyne early in the 16th century, or rather from the strips, first of hard wood and later of iron, which were used to "plate" these runways. The development was very slow as was also the development of RAILROAD MOTIVE POWER, and most early American roads of the early 19th century had the "strap-iron rail," although the "edge rail" introduced in 1789 had developed into the double-headed or bull-headed rail in England. This rail was supported by being wedged into chairs and could be cast only in three-foot lengths up to 1820, when the introduction of malleable iron (*see* IRON AND ITS ALLOYS) made it possible to cast lengths of 15 feet. It was not until 1730, however, that ROBERT L. STEVENS invented the "T" rail which is in common use to-day. He also invented the hook-headed spike and the splice or joint-bar. Steel rails were introduced in England about 1855 and in the U.S. about ten years later. During the first quarter of this century OPENHEARTH STEEL entirely replaced BESSEMER STEEL for rails. The standard length of rails is now 30 feet and most of those used for first-class track weigh from 110 to 140 or even 150 pounds per yard. F. A. B.

BIBLIOGRAPHY.—H. S. Haines, *American Railway Management*, 1897.

RAILROAD WORK EQUIPMENT. As many railroads carry on considerable reconstruction, and even new construction, EXCAVATING MACHINERY, and PILE-DRIVERS will form a part of their equipment, as well as the ballasting and track-laying equipment used in building the road. BALLAST may be distributed from flat or gondola cars with hinged sides by "plowing" it off. It may also be handled in side-dump or hopper cars, though the best distribution is obtained with a ballast car with discharge openings on both sides and in the center, any one, two or all three of which may be used at one time. "Spreader" cars are used for spreading dirt in filling, spreading ballast deposited in piles, and piling snow in yards so that it may be picked up with a power shovel or locomotive CRANE. Fitted with properly shaped arms it may be used for ditching, though most heavy ditching is done with small POWER SHOVELS.

Many small machines are used on the regular maintenance work, such as power tampers, spike pullers, spike drivers, power drills and wrenches, track raising machines, railgrinders, welders, and the like. These

are usually operated by AIR COMPRESSORS, driven by INTERNAL COMBUSTION ENGINES in portable units but some are operated by electricity. F. A. B.

RAILROAD YARDS consists of a set of two or more parallel tracks, called "body tracks," assigned to a specific purpose.

There are usually at least three yards for each direction in a complete freight terminal: *A Receiving Yard, a Classification Yard and a Departure Yard.* Incoming trains are switched into the receiving yard, engines are uncoupled and taken to the engine terminal and cabooses are placed on the caboose track. As the trains are moved into the classification yard, they are broken up and the cars switched to the proper classification track, according to commodity, destination or other basis of classification. From time to time cars are removed from the classification tracks and made up into trains in the departure yard for forwarding. If the classification yard is not capable of providing for all the classification desired, a fourth or "sorting" yard is added either before or after the classification yard.

Yards are operated by several methods, i.e., *Tail-Switching or Push-and-Pull, Poling, and Gravity.* The first two are used in all "flat" yards and the third where the natural ground slope is sufficient to move cars onto the classification tracks or in the "hump yard" where a hump is built up for the purpose. In tail-switching the yard engine pushes the train back and forth onto the various classification tracks, the cars being cut off until all are classified. In the poling method a small locomotive on a parallel track pushes the cars by means of a pole onto the classification tracks. This method obviates moving the entire train back and forth and is somewhat faster than the push-and-pull method but the hump yard is much faster, and most modern yards are of this type. In operation the yard engine simply pushes the train over the hump and the cars are uncoupled and allowed to run down the grade where they are switched onto the proper track.

As the distance the cars must travel varies greatly as the tracks fill up, and as heavy cars will run farther than light ones, it is necessary to control their speed on the classification tracks in order to avoid damage due to their bumping together. Until a few years ago this was done by having men ride the cars and apply the brakes to whatever extent was necessary, then walk or ride back to the hump for another trip. The larger yards are now reducing expenses by doing away with "car-riders" and installing CAR RETARDERS. If a car still has too much speed after passing the last retarder, a SKATE is placed on the rail and the car brought to rest, usually within its own length. Skate-placing machines, retarders and switches are all controlled from a tower so placed that the movement of all cars in that district can be watched. *See also* RAILROAD BUILDINGS; RAILROAD TERMINALS. F. A. B.

RAILS, for steam and electric railroads and for trolley lines, are rolled in a variety of shapes as L,

edge, girder, bullhead, T and others, according to the particular service they are to be used in. For railroads in the United States, the T shaped rail has been adopted as the standard shape, and is rolled from steel ingots, the specifications for which are usually prepared by the railroad ordering, subject further to chemical analysis, physical tests and inspection of the finished rail. Manganese steel is sometimes used on curves, where the wear is excessive.

Rails are generally rolled 30 to 40 ft. long, the weight per yard specified depending on the traffic. For heavy fast traffic the weight is from 105 to 125 lbs. per yard, although some roads are using weights of 130 to 140 and even heavier. The present practice is to replace worn out rails by heavier.

The ends of rails are connected together by angle bars with through bolts on each side. Rails are spiked to wood sleepers which are supported on stone ballast that is provided with water drains where necessary. As the rails have a tendency to cut into the sleepers (caused by the weight of the trains running over them) metal plates are placed between them and the sleepers.

The standard distance, usually called the gauge, between rails is 4 ft. $8\frac{1}{2}$ in. in United States, Great Britain and most European countries although some countries have other gauges as 3 ft 6 in., 5 ft. 3 in., and 5 ft. 6 in. On a double track standard gauge (4 ft. $8\frac{1}{2}$ in.) road, the centers of the tracks are 13 ft. apart.

RAIN, the most common form of precipitation, consisting of drops of water large enough to fall at a noticeable speed under the influence of their own weight. The larger raindrops, up to a quarter of an inch in size, appear to be associated with warm weather and thunderstorms; the smaller drops, down to one twentieth of an inch with low temperature conditions. Since the air resistance increases with diminution in size of a falling particle, the smallest rain drops also have the lowest speed. In a drizzle the waterdrops fall much more slowly than in a tropical downpour, the actual velocities being about 5 and 20 feet per second respectively. Drops still smaller have an almost imperceptible downward motion, and are classed as Mist or Fog.

Rain is formed by the condensation of water vapor in the atmosphere which may be effected in a variety of ways: by the upward motion of air to higher altitudes, by the mixing of two currents of air of different temperature or by the blowing of warm air toward the poles. Raindrops will not form except in the presence of fine dust or electrically charged particles which act as nuclei for the condensation of vapor. This condition is the basis for the method of artificially producing rain, e.g., taking up fine sand in an airplane and throwing it out after it has been electrically charged. Although some success in these experiments has been attained, the actual cost is still prohibitive even when an entire crop is threatened with destruction by a prolonged period of drought. Except for such small central nuclei and some minute

organic material or dissolved gases raindrops constitute chemically pure water.

RAINBOW, a luminous colored ring seen in the sky when the sun's rays fall directly upon and are reflected by falling raindrops. The principal rainbow is a circle with a radius of 42° whose center lies diametrically opposite the sun and hence below the horizon. It contains all the colors of the spectrum, with violet inside, and red outside. Often a secondary, much fainter, arch may be seen, concentric with the first, and having a radius of 54° where the order of the colors is reversed.

The rainbow is produced by the rays of light falling upon raindrops, entering them, and being reflected *inside* them; the principal bow corresponding to one reflection, the secondary bow to two. The brilliance of the colors and their relative strength depends upon the size of the drops. In fog, where the water is condensed into very fine particles, the "fogbow" is almost white. A rainbow may sometimes be seen by sunlight reflected from water, in which case its center is above the horizon, or may be seen in moonlight when it is very faint; or in the spray of a waterfall, when it can be almost as brilliant as in the sky.

RAINBOW BRIDGE, a national monument established by presidential proclamation on May 30, 1910, is a tract 160 acres in extent just north of the Arizona line within the territory of the Piute Indian Reservation in southern Utah. It contains the largest natural bridge in the world. This bridge was first seen by white men on Aug. 14, 1909, when Professor Byron Cummings, then of the University of Utah, and W. B. Douglass, surveyor of the General Land Office, were guided to it by a Piute Indian. Of salmon pink sandstone, its almost perfect proportions roughly resemble a rainbow arch, the meaning of its name in both the Piute and Navajo languages. It partly spans Bridge Canyon, which extends from Navajo Mountain in Arizona northwestward to the Little Colorado River. The height of the bridge is 309 ft. from the bottom of the gorge to the underside of the arch and 278 ft. from pier to pier.

The trip to Rainbow Bridge is made by pack train from Rainbow Lodge at the foot of Navajo Mountain, the round trip requiring at least three days. The lodge is reached by automobile from Flagstaff on the Atchison, Topeka and Santa Fé Railroad and the National Park-to-Park Highway or from the Grand Canyon National Park. The ruins of the NAVAJO NATIONAL MONUMENT can also be visited by short pack train trips from Rainbow Lodge.

RAINEY, HOMER PRICE (1896-), American educator, was born in Clarksville, Tex., Jan. 19, 1896. He studied in the University of Chicago, receiving the A.M. degree in 1923 and the Ph.D. degree in 1924. He had previously been an instructor in Austin College (1919-22) and in 1924 was appointed an associate professor of education in the University of Oregon. In 1927 he was chosen president of Franklin College, Ind., and served in that

capacity until his appointment to the presidency of Bucknell University of Lewisburg, Pa., in 1931. He has contributed frequently to educational journals and is well known for his monograph on *Public School Finance* (1929).

RAINFALL, the amount of water precipitated from the atmosphere during a given period of time. It is measured by means of a rain gauge and is usually expressed as a depth of water, in inches. When given for a longer period of time, such as a year, it includes all other types of precipitation such as snow or hail. Rainfall in any particular area is dependent upon a number of conditions, principally upon the prevailing winds and the regions from which these come, the distance from the sea, the altitude and the location with respect to mountain ranges.

In the temperate zone of the northern hemisphere where the prevailing winds are southwest, the west coasts of the continents receive more rain than the interior. On the Pacific coast in the Northwest there is heavy rainfall, but once the winds have climbed the high mountain ranges, they pass over the desert and the Rockies without much further precipitation. The warm winds, blowing northward over the Indian ocean do not deposit much moisture when they first strike land in India, but once they start climbing the mountains precipitation becomes heavy, in some localities 18 times more in the zone of maximum rainfall than at the coast. The Sahara and Arabian deserts are dry, because the trade winds, blowing from cooler to warmer, and lower latitudes are dry winds. Generally speaking forest regions are better rain catchers than meadows; hills better than plains. Rainfall is heaviest in the tropics, on the average, with a gradual decrease through the temperate zones toward the poles—with some glaring exceptions, however.

The total annual rainfall is observed in a large number of localities and the average values obtained from observations over a number of years are plotted on a map of the world, places with an equal rainfall being joined by lines. These curves are called *isohyets* and indicate the contours of moist and dry areas. The average rainfall over the whole earth is probably about 29 inches annually, about 100 inches at the equator and not more than 10 to 15 inches near the poles. The driest places on earth may have a rainfall of well below one inch per year, and several years may pass without any precipitation at all.

The wettest place in the United States appears to be in the State of Washington with an average annual fall of 128 inches. In Europe it is in the Gulf of Cattaro in the Adriatic, with 183 inches, though Ben Nevis, in Scotland receives over 160. The wettest place on earth is Cherrapunji on the southern slopes of the Khasi Hills northeast of Calcutta, with an average annual rainfall of over 450 inches. In this same locality it once rained as much as 41 inches in 24 hours, and 114 inches in five days. At Graz, Austria, a fall of 26 inches in four hours has been recorded, which for intensity may still be surpassed

by a cloudburst: 2.5 inches in three minutes and one inch in one minute have been observed in Panama and in California respectively. W. J. L.

RAIN GAUGE, an instrument for measuring rainfall, consisting in its simplest form of a bucket in which the depth of water is measured by means of a graduated rod. In recent years more accurate instruments have been devised which even allow of automatic registration on a sheet of paper of the quantity of water collected.

RAINIER, MOUNT, the highest peak in the Cascade Mountains, situated in Washington slightly southeast of Tacoma. It is a majestic volcanic cone towering fully 10,000 ft. above its base and reaching to 14,408 ft. above sea level. From the thick snow and ice pack covering its summit 28 glaciers radiate down its gashed slopes and below the snow line turn into rushing rivers or feed quiet mirror-like lakes. The lower slopes of the mountain are encircled by a belt of dense evergreen forests, and above them the wide alpine meadows carpeted with vividly colored flowers extend upward to the snowfields. The peak is the center of an area of 324 sq. mi. set aside as Rainier National Park.

RAISE, in mining, an underground excavation, driven upward from a **DRIFT**, usually in the ore body. It is used for ventilation, as a manway, or passage for men, or for conveying the broken ore to the main level. *See also* CAVING; MINING, METAL.

RAISIN, WILD, a name given to the **NANNY-BERRY**, a North American shrub producing a sweet, blackish, persistent fruit, which, when partly dried on the branches, somewhat resembles raisins.

RAISIN RIVER, BATTLE OF, Jan. 22, 1813, an engagement of the **WAR OF 1812** which resulted in a British victory. Word that the British contemplated the seizure of Frenchtown (now Monroe, Mich.) as a point at which to intercept Gen. Harrison's expedition to Detroit, reached Gen. Winchester, commanding Harrison's left wing. He dispatched 660 men under Colonels Lewis and Allen to relieve the town, and himself followed later with 250 more. Meanwhile Frenchtown was occupied by British troops under Col. Elliott. Lewis and Allen were attacked at the Raisin River, beside the town, on Jan. 18, but forced the British line back about two miles, with a loss of 12 killed and 55 wounded; the British loss was much heavier. Winchester joined the victors at the Raisin River; he took no measures for defending the camp, and carelessly sent out no spies. Before dawn on Jan. 22 a British force of 500 under Col. Proctor, with 600 Indian allies, overwhelmed the American force in a surprise attack. The battle became a massacre unrestrained by conventions of ordinary warfare. About 400 Americans were killed, 500 taken prisoners, and less than 40 escaped to rejoin Harrison.

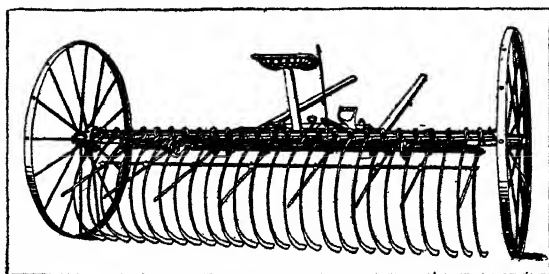
RAISINS, the dried fruit of varieties of grape having a high sugar content. They are prepared by drying the picked grape clusters on trays or by partly cutting the stem and leaving the grapes to dry on the

vine; also by heating grapes in an oven. Certain varieties of grape are sometimes prepared for drying by dipping them in a hot soda solution. As sun drying requires a warm, exceedingly dry climate, commercial raisin production is limited almost entirely to the Mediterranean countries, California and Australia. There are three principal varieties, (1) the large raisin, commonly prepared from muscat grape; (2) the Sultana or Thompson seedless variety and (3) the small currant. California production consists mainly of the Thompson seedless and a seed-bearing raisin from the muscat grape. In 1929, California produced 1,691,111 tons of grapes of which 980,724 tons were raisin grapes. The United States exported 128,585,000 lbs. of raisins in 1930.

RAJPUTANA, a region in northwestern British India, composed of 19 native states and one chiefship; area, 128,987 sq. mi. It derives its name from Rajput, the term for the warrior caste which inhabits the region. The chief states are JAIPUR, Udaipur, BIKANER, JODHPUR, Buhrtpur, Alwar, Dholpur, Kotah and Tonk. Rajputana is divided by the Aravalli Mountains, extending from northeast to southwest. In the west the country is composed of sand hills, with little rainfall and few possibilities for irrigation. In the east and northeast are tablelands and plains. In this territory the soil is richer and the rainfall heavier. In the western region there is little agriculture but there are extensive herds of cattle. The eastern section is an important cattle-raising district and considerable crops are raised. Salt is the chief mineral of Rajputana. Cotton and wool products are the principal manufactures. Mount Abu is the headquarters of the Agent to the Governor-General of India. Pop. 1921, 9,844,384; 1931, 11,223,708.

RAKES, implements provided with pegs or teeth and used for stirring and spreading earth and for gathering hay. Hay that is windrowed by dump and side-delivery rakes is collected into bunches by sweep rakes, sometimes called buck or bull rakes, and carried either to the stack or to the press where it is baled.

Side-delivery rakes roll the hay from the swath into a continuous windrow. They consist essentially



DUMP TYPE HAY RAKE

of a freely revolving drum about 22 in. in diameter and about ten ft. long. The axis of the drum makes an angle of about 45° with the direction of travel. As the rake moves forward the drum revolves and

the hay is pulled to one side by means of spring steel teeth, which are about eight in. long and are attached to the drum.

BIBLIOGRAPHY.—H. P. Smith, *Farm Machinery and Equipment*.

RALEIGH, SIR WALTER (c. 1552-1618), British soldier and colonizer, was born in Devonshire about 1552. In 1568 he entered Oriel College, and the following year went to France in the cause of the Huguenots. There is some evidence that he was present at the battle of Jarnac in 1569. In 1575 he took up residence in the Temple. Three years later he accompanied his half-brother, Sir Humphrey Gilbert, on a piratical raid on the Spaniards, commanding the *Falcon*. He was arrested for duelling in 1580, but his patrons, the earls of Oxford and Leicester, managed to protect him. In 1581, after taking an emphatic part in the suppression of the Desmond's in Ireland, he came home to fall into high favor at the court of Elizabeth. At this time occurred the alleged act of covering with his mantle the puddle in the path of the queen. From 1583-1586 a number of favors were bestowed on him including knighthood and 40,000 acres in Ireland, which he planted with potatoes and tobacco. However, he did not receive one high office at this time. From 1584 to 1589 he engaged actively in attempts to colonize the land in America which he called Virginia, sending out explorers in 1584 and settlers in 1585. The latter under Sir Richard Grenville settled on Roanoke Island, but, dissatisfied with the aborigines, left in 1586. When Sir Walter's attempts at colonization failed later in 1586 and 1587, Raleigh surrendered his patent in 1589.

From 1587 until his death Raleigh's influence at court rapidly waned, and he never returned to his old height of favor under Elizabeth. In 1592 he was married to Elizabeth Throgmorton, a maid of honor to the queen, by whom two sons, Walter and Carew, were born to him. Having retired to his estate in Ireland, he grew weary of inactivity, and embarked for South America in 1595. Upon his return he published *The Discoveries of Guiana*. His service in the capture of Cadiz renewed his favor somewhat, and in 1600 he was made governor of the island of Jersey. In 1601 he participated in the execution of Essex, his enemy.

His serious reverses began under James I, who took away his military and civil offices, and finally saw that he was imprisoned in the Tower in 1603 for complicity in an intrigue against the king. He was sentenced to death, but was not executed, remaining in the Tower until 1616. In that year he promised James I to find a gold mine in Guiana not within the Spanish claims, and sailed in 1617. Falling ill with fever, Raleigh dispatched an expedition up the Orinoco including his son Walter. In a fight with Spaniards on the way Walter was killed. Upon the return of the ill-fated Raleigh, James I, to keep his promise to Spain to put Raleigh to death should he encroach on Spanish claims, had him executed under the sentence of 1603 on Oct. 29, 1618.

RALEIGH, the capital of North Carolina and the county seat of Wake Co., situated near the Neuse River, about 25 mi. southeast of Durham. Raleigh is the market center of an agricultural region raising cotton, tobacco, and corn. Textile manufacture and a large wholesale and retail trade are the important industries. In 1929 the value of the factory output was about \$6,000,000; the retail trade amounted to \$23,401,823. In 1787 the North Carolina state convention agreed to purchase the land on which a capital should be built. The site of the city was bought from Joel Lane. It was incorporated in 1792, and named for Sir Walter Raleigh. The beautiful state capitol was completed in 1840. The Joel Lane Mansion and the house where ANDREW JOHNSON was born are of interest. Raleigh is an educational center, the seat of North Carolina State College of Agriculture and Engineering, St. Mary's School, Meredith College and also St. Augustine College and Shaw University, the latter two for Negroes. The State Museum, the State Law Library and several state institutions are located here. Bus lines, truck lines, and three railroads serve the city. The Curtiss-Wright Airport and Flying School, approved by the United States Department of Commerce, is situated near Raleigh. Pop. 1920, 24,418; 1930, 37,379.

RAMADHAN or **RAMAZAN**, the ninth month of the Moslem lunar year, the month of the annual fast. The fast of Ramadhan is one of the five branches or pillars of Islam, and those who keep it (daily from dawn to dark) receive pardon for all previous pardonable sins. (Koran 2:179-184.) If the fast falls in the long, hot days of summer, the keeping of it is extremely rigorous. Formal as it is, Ramadhan was intended to be of moral and spiritual benefit to the faithful.

RAMAKRISHNA (1836-86), Indian religious leader, born at Kamarkpur, Bengal, Feb. 18, 1836, and died at Dakshineswar, on the Ganges some four mi. from Calcutta, on Aug. 15, 1886. He came of a poor but pious old orthodox Brahman family. Traditions which sprang up had it that he was one of the several in Indian history who were immaculately conceived, the legend being that Shiva was his father. He was a joyous child, but as early as six years of age he began to have "ecstasies." In his later life he developed the technic of passing from meditation into a state of coma and back to consciousness at will, following and developing the ancient Hindu Yogi practices. At the age of 20 he became the priest in a temple to Kali, the *Mother*, at Dakshineswar, and he retained this post until his death. The temple was an important pilgrim center, and Ramakrishna soon began to discuss religious matters with pilgrims of all faiths who came to the temple neighborhood as well as with other religious leaders, Indian and foreign, whom he sought out. He became well acquainted with and had considerable influence upon many of the leaders of the religious and political movements in India during his lifetime, but he actively associated himself with none of these movements. He came in-

creasingly to see himself and to be thought of by his disciples as one of the series of divine incarnations which, according to Indian religious belief, have occurred at various times when men were in particular need of enlightenment. He taught that all religions are true in their essence, and that each represents an attempt on the part of men to arrive at the supreme truth. His greatest and best-known disciple was VIVEKANANDA.

RAMAN EFFECT, a phenomenon of physics dealing with the changes in the COLOR of LIGHT scattered by MOLECULES. It offers a proof of the corpuscular nature of light rays in the same way that the change in wave-length of X-rays by electrons (*see* COMPTON EFFECT) demonstrates the granular nature of X-rays.

Sir C. V. Raman, in 1928, studied the light which had been scattered at right angles by various dust-free liquids. As a source of light he used a mercury arc, as a receiver, a SPECTROSCOPE, which resolved the light into its separate colors. He found that, for a given spectral color in the original beam, the faint scattered light contained many colors, one of which was the same as that of the incident beam. The others, exceedingly faint and referred to as the Raman Lines, had colors, or wave-lengths, on both sides of the unmodified color.

The amount of color modification due to the interaction of the light with the molecules depends on both the color of the incident light and the nature of the molecules. The modified colors differ in frequency from the original by the same amount as does the frequency of the infra-red absorption bands of the scattering molecules. This observation offers a simple and powerful means of studying the structure of complex molecules. The Raman Effect has been observed with gases, liquids and solids. J. B. H.

RAMAZZINI, BERNARDINO (1633-1714), famous Italian physician, whose name is associated with trade diseases and industrial medicine. He was the first, after Paracelsus, to recognize such conditions as stone-mason's and miner's tuberculosis, vertigo and sciatica of potters, and eye disturbances of gilders, printers and certain other industrial workers. He was an excellent epidemiologist, describing the outbreak of the malarial epidemic and several others.

M. F.

RAMBAM. *See* MAIMONIDES, MOSES.

RAMBAN. *See* NAHMANIDES, MOSES.

RAMBOUILLET, CATHERINE DE VIVONNE, Marquise de (1588-1665), French social leader, was born in 1588. At the age of 12 she was married to the Marquis de Rambouillet. She greatly disliked the tone and atmosphere of the French court and determined to establish a social circle of her own in the Hotel de Rambouillet, her husband's Paris home. Her success as a hostess was remarkable, notwithstanding the strict insistence on formal manners that prevailed at her social functions. Conversation was developed into a fine art and learning was venerated. Molière's *Précieuses Ridicules* is based on the numerous and stupid imitations of this circle that

sprang up as a consequence of its renown. Madame de Rambouillet died on Dec. 2, 1665.

RAMEAU, JEAN PHILIPPE (1683-1764), French composer and musical theorist, was born at Dijon, Sept. 25, 1683. He showed talent as a child, and in early manhood became a proficient organist, playing at Clermont and Avignon cathedrals, and at the church of Ste. Croix de la Bretonnerie, Paris. In 1723 he made his début as a dramatic composer with *L'Endriague*. Neither this nor its immediate successors proved popular. In 1735, however, he produced an opera-ballet *Les Indes galantes*, and two years later *Castor et Pollux* which is commonly considered his masterpiece. His successive operas dominated the French stage for three decades. As a royal reward the composer was raised to the nobility, a fact which did not lessen the jealousy of his contemporaries in music. In addition to his dramatic works he composed numerous pieces for the harpsichord. His most substantial fame, however, resides in the field of musical theory which he explored with inspired inquisitiveness. He first stated the principle of the harmonic identity of the inversions of a chord and the parent chord in fundamental position (see ROOR and INVERSION). His chief writings in this field were *Traité d'harmonie* (1722), *Nouveau système de musique théorique* (1726), *Génération harmonique* (1737), and *Démonstration du principe de l'harmonie* (1750). He died at Paris, Sept. 12, 1764.

RAMÉE, LOUISE DE LA (1839-1908), English novelist who wrote under the name "Ouida," was born at Bury St. Edmunds, Jan. 1, 1839. She moved to London in 1859 and in 1874 settled in Italy. Ouida wrote numerous popular novels of military and society life, such as *Under Two Flags*, 1867, and *Idalia*, and some notable juvenile stories, including *The Nurnberg Stove* and *A Dog of Flanders*. Her anti-vivisectionist and anti-suffragist views are expressed in *Views and Opinions* and *Critical Studies*. Ouida died at Viareggio, Italy, Jan. 25, 1908.

RAMESSES I (about 1350 B.C.), founder of the 19th dynasty, sometimes identified with Menpehre, ascended the Egyptian throne at the death of the wise ruler, Harmhab, who had reorganized the nation and restored to it prosperity. Nothing is known of the early life of Rameses I or the manner in which he became pharaoh. He was already an old man upon his accession, and proved too feeble to continue the work of his worthy predecessor. His reign was short, lasting about two years, in the latter part of which he shared the regency with his son, Seti I. He planned and began to build the celebrated Hypostyle Hall at Karnak, which was completed by his successors. Upon his death, he was buried in a tomb in Western Thebes, and Seti I became sole ruler.

RAMESSES II (1292-1225 B.C.), Egyptian pharaoh, third ruler of the 19th dynasty, was the son of Seti I, whom he succeeded at an early age. Wishing to restore to Egypt some of her lost realms, he began a series of military campaigns which brought him, over a period of years, in conflict with the Nubians, the

Libyans, the Syrians and the Hittites. Parts of Palestine and Syria were regained during these wars.

In the fifth year of his reign, Rameses engaged in a great battle with the Hittite hordes near Kadesh on the Orontes, and there turned seeming defeat into a brilliant victory. After 16 years of intermittent struggle, a peace treaty was finally concluded between the pharaoh and the Hittite king, Khattusil (Khetasal). Rameses thereafter devoted himself to the development of Egypt's industry and commerce, and to building new temples and restoring old ones. His inscriptions in praise of himself are found almost everywhere in Egypt.

He completed the great Hall of Columns at Karnak, and also finished the magnificent rock-hewn temple at Abu Simbel, setting up before it four colossal statues of himself. The funerary temple of the Ramesseum, built by him at Thebes, is one of the most imposing ancient buildings in Egypt.

Rameses married many wives, and had 111 sons and 51 daughters. By some scholars he is identified with the cruel pharaoh of Mosaic tradition. He reigned 67 years, and at his death was succeeded by his 13th son, Meremtah I.

RAMIE (*Bœhmeria nivea*), an important fiber plant of the nettle family native to eastern Asia and Malaya and widely cultivated in tropical and subtropical regions. It is an erect, much branched herb or subshrub, 3 to 8 ft. high, with broad, long-stalked leaves, woolly-white below, and inconspicuous flowers. The stems yield a valuable fiber, much stronger than hemp and almost equal to silk in luster, used in making various fabrics, cordage and nets and also in the manufacture of certain kinds of paper as, for example, that used in bank notes. Large quantities of ramie are produced in China and India; ramie has been experimentally grown for fiber in California and Florida and is also planted for its ornamental foliage.

Ramie Manufacture. In China, where ramie is most extensively used, the fiber is prepared entirely by hand methods. The bark including the fiber is stripped off from the stalks, and the thin outer bark, most of the green coloring matter, and some of the gum, are scraped away, leaving the hand-cleaned but not degummed fiber in the form called China grass. It is degummed and bleached by repeated washing and drying in the sun. This method produces a remarkably strong and durable fiber, which is spun and woven by hand into fabrics used for clothing. Strands of ramie fiber carefully prepared, but not spun or twisted into yarn, are woven into the so-called "grass cloth" that is used, especially in Swatow, for doilies, lunch cloths and various embroidered pieces.

In Japan ramie fiber is decorticated by a machine, and it is spun in flax spinning mills. It is used chiefly in mosquito nets and seine twines. Ramie spinning mills in Germany, France and England obtain the fiber from China in the form of China grass. It is degummed either by retting or by chemical methods at the mills and after BLEACHING and COMBING it is spun (see SPINNING) by special machinery. The

yarns are used in "stockings" for incandescent gas mantles and in Germany ramie yarns are used in trimmings, draperies, dress goods, furniture covering, pile fabrics, tapestries, table napkins, and towels.

The ultimate cells of ramie fiber are from 1 to 15 in. long—longer and stronger than those of any other textile fiber, but without special treatment they are rather stiff and do not cling together as well as flax or cotton when twisted into yarn. L. H. D.

RAMONA, a romance of the American Indian, by HELEN HUNT JACKSON; published 1884. Ramona, a beautiful Scotch and Indian half-breed, runs away from the ranch of her foster-mother, Señora Moreno, with her Indian lover, Alessandro. She lives with her husband's people, sees them robbed of their land and reduced to poverty by the heartless encroachments of the expanding United States, and at last beholds the noble Alessandro driven to madness and a tragic death by these wrongs.

RAMON Y CAJAL, SANTIAGO (1852-), Spanish histologist, born May 1, 1852, at Petilla de Aragon. He graduated from the University of Saragossa, and became professor at the University of Valencia in 1881, and at Barcelona in 1886. Ramon y Cajal is particularly noted for his contributions to the minute anatomy of the nervous system. He devised a new method of staining the tissues of the body so they might more easily be studied under the microscope, and illustrated the manner in which the terminals of the nerves ramify into the brain and spinal cord. In 1900 the International Congress of Medicine gave him the Moscow International Award, and in 1906 he received half the Nobel prize in medicine. M. F.

RAMSAY, ALLAN (1686-1758), Scottish poet, was born at Crawford, Lanarkshire, Oct. 15, 1686. While a bookseller in Edinburgh he started the first circulating library in Scotland, and sold his own verses for a penny a sheet. His *Scot Songs* appeared in 1719, his collected verse two years later, then the coarsely humorous *Fables and Tales*. The *Tea Table Miscellany*, an anthology mainly of old Scots poetry, contains *The Vision*, generally considered his best long lyric. *The Evergreen* anticipated Percy's *Reliques*. *The Gentle Shepherd* was long ranked the best of all pastoral comedies. He died at "Ramsay's Lodge," Castle Rock, Edinburgh, Jan. 7, 1758.

RAMSAY, SIR WILLIAM (1852-1916), English chemist, was born in Glasgow on Oct. 2, 1852. Studying at Glasgow and Tübingen, he became assistant in Glasgow in 1874, professor of chemistry at Bristol in 1880, and professor of University College, London, in 1887, as successor to A. W. Williamson. Although his work covers a wide range of subjects, and he is equally famous as a teacher, as a research worker and as an experimenter, his name is perhaps most closely associated with the inert gases. In collaboration with Lord Rayleigh he investigated the discrepancy existing between the density of atmospheric nitrogen and that obtained from chemical sources, which led to their joint discovery of argon, the first inert gas, in 1894.

The next year Ramsay alone obtained helium by heating cleveite, and, in an exhaustive investigation of the residue of liquid air, Ramsay and Travers identified three more gases, neon, krypton, and xenon. One of his crowning achievements was the determination of the density and atomic weight of the last inert gas, niton, although he had less than one millionth of a cubic inch of it at his disposal. He received the Davy medal in 1895, was knighted 7 years later, and, together with Lord Rayleigh, received the Nobel prize in 1904. He died at High Wycombe, Buckinghamshire, on July 23, 1916.

RAMSGATE, a municipal borough, watering-place, seaport and member of the Cinque Port of Sandwich, in Kent, England, 79 mi. southeast of London. Originally small but prosperous, in 1749 it was made a harbor of refuge for the Downs. The churches and municipal buildings are modern, and there is a fine seafront and promenade pier to attract visitors. During the World War a large aerodrome nearby caused it to suffer from consequent raids. Pegwell Bay, the landing place of St. Augustine in 596, is famed for its shrimps. Besides seasonal steamer connections with London and the Continent, Ramsgate employs its 42-acre harbor in a large coasting and fishing trade. Pop. 1921, 36,561; 1931, 33,597.

RAMSONS (*Allium ursinum*), an attractive bulbous plant of the lily family closely allied to the LEEK and ONION. It is native to woods and hedge banks in Europe and Asia bearing a cluster (umbel) of small white flowers in early spring. The plant grows about a foot high with thin flat leaves which have a pungent, garlic-like odor. See also ALLIUM.

RANCAGUA, a town of Chile and capital of the province of Colchagua, formerly capital of the extinct province of O'Higgins. It is the center of an agricultural district producing cereals and fruits. A narrow gauge railroad rising from an altitude of 1,600 ft. to one of 7,000 ft. connects Rancagua to the large copper mines located in the Sewall district, 45 mi. distant. Pop. 1930, 23,339.

RANCHO LA BREA, a ranch, now a park, in the outskirts of Los Angeles, Calif. It contains the famous "death-trap" tar pools and asphalt beds from which since 1906 the well-preserved bones of thousands of prehistoric animals have been recovered. An area approximating one square mile holds asphalt deposits through which at many points small craters exude crude oil or soft tar. The pit from which commercial "brea" (asphalt) was long dug, is now occupied by "Brea Lake," a thick, black iridescent water pool fed by tar-springs.

In Pleistocene times, as now, the treacherous nature of the footing round the tar-pools was disguised by crusting and a film of dust. Birds and other animals, venturing upon it to drink, were caught in the sticky tar, and perished. The cries of mired animals attracted beasts of prey, which in turn became victims of the tar.

Among interesting discoveries in the fossil beds are a gigantic American lion, a huge carnivorous bird

(*Teratornis*) a fossil peacock hitherto unknown in America, a mastodon, extinct elephant, camel, horse, and bison forms, many saber-toothed tigers, great bears, wolves, and giant sloths, and many species of predatory birds.

RANDALL, JAMES RYDER (1839-1908), American poet and journalist, was born at Baltimore, Md., Jan. 1, 1839. He was educated at Georgetown College, and became a journalist. The news of fighting in Baltimore, in 1861, inspired the famous lyric, *Maryland, My Maryland*. Among his other poems are *Stonewall Jackson* and *There's Life in the Old Land Yet*. After the war Randall edited *The Constitutionalist*, of Augusta, Ga., and then the *Morning Star*, of New Orleans. He died at Augusta, Ga., Jan. 14, 1908.

RANDALL, SAMUEL JACKSON (1828-90), American public official, was born at Philadelphia, Pa., Oct. 10, 1828. He attended University Academy, and after working in Philadelphia as a silk salesman, he became a partner in the firm of Earp and Randall, iron manufacturers. In 1858, as a Democrat, he was elected to the state Senate and in 1862, again as a Democrat to the House of Representatives, where he served until his death. During the Civil War he rose from orderly sergeant to captain in the 2nd U.S. Cavalry, and was later promoted to provost-marshal. From 1876-81 he was Speaker of the House. Although a Democrat, he believed in a protective tariff but refused money to aid his election as a champion of protectionism. He was a loyal Pennsylvanian and often seemed to place the welfare of his state above that of the nation in the passage of legislation. He believed in strict personal and national economy and in his 28 years of service in Congress he gained the reputation of Democratic "watch-dog" of the Treasury. He died in Washington, D.C., Apr. 12, 1890.

RANDERS, a city of Denmark, in Jutland, located about 20 mi. northwest of Aarhus where the Gudenaa enters the Randers-Fjord. Among notable buildings is the Church of St. Marten, built in the 14th century, and a medieval monastery now used as a high school. The city is particularly known as the scene where, in 1340, Niels Ebbesen assassinated Count Gerhard. Randers has important distilleries and railway manufacturing shops. Pop. 1925, 26,856.

RANDOLPH, EDMUND JENNINGS (1753-1813), American public official, was born at Williamsburg, Va., Aug. 10, 1753. He studied law at William and Mary, and began his career in 1775 as aide-de-camp to Washington. In 1779 and during 1780-82 he served in the Continental Congress, and in 1787-88 was Governor of Virginia. At the Philadelphia Convention of 1787 he submitted the plan for a new government which was known as the Virginia plan. He declined to sign the new Constitution because of the provision that it had to be accepted or rejected without alteration. Nevertheless, in the Virginia convention for ratification of 1788 he voted for its adoption. In 1789 Washington appointed him first Attorney General, and five years later he succeeded Jefferson as

Secretary of State. He opposed the Jay Treaty in 1795 and the British Minister turned over to Washington a captured French despatch which indicated intrigues between Randolph and France. Although Randolph issued a long defense and the charge was never proved, the episode led to his resignation and political ruin. He later resumed his law practice in Virginia, and died at Millwood, Clark Co., Va., Sept. 12, 1813.

RANDOLPH, JOHN, of Roanoke (1773-1833), American statesman and orator, was born at Cawsons, Va., June 2, 1773. For brief periods he attended William and Mary, Princeton, and Columbia colleges. In 1799, after a short period of law practice, he was elected to Congress, and was a member of the House of Representatives for 1799-1813, 1815-17, and 1819-25, and was elected to the Senate for 1825-29. Early in his public career he led the Democratic-Republican opposition against the Federalists. The Yazoo controversy (see YAZOO CLAIMS) led to Randolph's hostility to Jefferson and Madison. He became a constant tormentor of Republican administrations, proclaiming that he was no longer a Republican but a member of the third party, the Quids, from *tertium quid*, that third nameless thing. His opposition lacked any consistent purpose and was usually perverse and erratic. He was opposed to slavery, and by his will freed and provided for his slaves, and he was one of the first to predict that slavery would cause a civil war. His fame is due chiefly to the pungency of his speeches in Congress, when moved to lash out at government abuses. Randolph was a leader in the impeachment proceedings against Justice Chase, and denounced the Yazoo frauds. In 1830 President Jackson sent him as Minister to Russia. He died at Philadelphia, Pa., June 24, 1833.

RANDOLPH, PEYTON (1720-75), American patriot, was born in Williamsburg, Va., in 1720, and studied law in London. In 1748 he was appointed attorney-general of the King for the Colony of Virginia and served in this capacity until 1766 when he resigned to devote himself to the patriot cause. He became a delegate to the First Continental Congress at Philadelphia in 1774 and was elected president thereof. The following year he was reelected and shortly after taking office died at Philadelphia, Oct. 22, 1775.

RANDOLPH, a town in Norfolk Co., eastern Massachusetts, situated 15 mi. south of Boston. It is served by buses and the New Haven Railroad. The local manufactures include shoes, paper boxes and portable buildings. Flowers and market-truck are grown in the vicinity. The town, once a part of Braintree, was incorporated in 1793. It was the birthplace of Mary Wilkins Freeman, the writer, and is the seat of the Boston School for the Deaf. Pop. 1920, 4,756; 1930, 6,553.

RANDOLPH-MACON WOMAN'S COLLEGE, at Lynchburg, Va., was founded in 1893 by Dr. W. W. Smith, who became its first president. It is controlled by the Methodist Episcopal Church.

South. The productive funds in 1931 amounted to \$1,012,667. The library contained 30,000 volumes. In 1930 there were 830 students and a faculty of 63, headed by Acting President N. A. Pattillo.

RANGE FINDER, or telemeter, an optical measuring instrument, designed primarily for military use, by which the distance to a target is measured. In the coincidence type of range finder, the observer views the target divided into two parts by a sharply defined line. In general, the two portions of the target do not match, but, by rotating a knurled head, the image is made perfect, i.e., coincidence is obtained. The range is then indicated on a scale. In one type of the stereoscopic (*see* STEREOSCOPE) range finder, the observer sees the target in exaggerated stereoscopic relief and also an indicating mark which appears to approach or recede as a knob is turned. The indicator is caused to appear in the same plane as the target, and the range is then indicated on the scale. Range finders determine the range by a measurement of the PARALLAX of the object viewed from the two ends of a base line which is contained within the instrument. The size of the range finder is designated by the length of this base line. Range finders have been built with base lines ranging from 20 in. to 100 ft., the instruments with the longer base lines being effective at the greater ranges. The *height finder* is a range finder which indicates the range and the height of aircraft above the horizontal plane through the observation point. I. C. G.

RANGER, a city of central Texas in Eastland Co., 100 mi. southwest of Fort Worth. Two railroads, bus lines and an airport serve the city. The discovery of oil in the district in 1917 changed a tiny settlement into a busy and prosperous city. Cotton, grain, sorghum and peanuts are the chief crops of the region. The principal manufactures are gasoline and oil products. Scenes from *Flowing Gold* by Rex Beach are laid in Ranger. The city was founded by Texas Rangers in 1873. Pop. 1920, 16,205, 1930, 6,208.

RANGES are classed as electric, gas, tank gas, oil and coal. The outstanding characteristics of modern ranges are: 1. Automatic controls of temperature and time; 2. Insulated and heat-balanced ovens; 3. High-speed burners; 4. Porcelain enamel finish in color; 5. Accessibility of all parts of the range. The modern ranges release the housewife from constant attendance in the kitchen and, more important, removes much of the guesswork from cookery. Modern cookery is based upon: Accuracy of ingredient measurement, oven temperature, and cooking time. Practically all electric ranges and some gas ranges, are equipped for time control, though the "clock" control is usually sold as optional equipment.

Other improvements in the new gas and electric ranges are ovens with aluminum and enamel linings; rounded corners and removable oven bottoms; sliding racks; spring door suspension; two-section broiler pans; and, in some of the ranges, drawer-type broiler ovens.

All types of ranges mentioned are now available in

porcelain enamel finish, so that the lowly range of former years is no longer just an appliance on which food is cooked, but is, because of its attractiveness, an addition to the kitchen's general decorative scheme. The coal-burning range has been redesigned along more simple lines and now has an enamel finish. Popular colors for ranges, judging from the finishes offered by the majority of range manufacturers are green, ivory, white and black. F. C. L.

RANGING, the art of placing artillery fire upon a desired objective. It involves laying the GUNS both for distances or range and for direction. Up to recent times ranging was conducted by firing successive shots at the objective, until two were observed, one over, and one short of the objective, and sufficiently close to it. The mean of the range of these two shots was then taken as the correct range. This method is now seldom used.

In modern battles, objectives are rarely seen; they are hidden behind hills, or in woods, villages or other obstacles, or they may be concealed by darkness, fog or artificial smoke clouds. At times, objectives fired at are below the horizon; for example, the firing by the Germans on Paris, and by other nations on distant cities, during the World War. Artillery fire now occurs largely at night, in order to have the battlefield shelled before daylight, so as to enable the infantry to obtain an early start in its attack.

To meet these new conditions, improved methods of ranging have been developed. The positions of the guns are first accurately located by survey; the objects to be fired at are similarly located. As it is impossible to directly survey the enemy's positions, locations within his lines are obtained by photographs taken from planes, from statements of prisoners, observations made from captive balloons and sound ranging. These locations are plotted on the map, and the distances to them from the positions of the guns are the map ranges. Corrections are made in these ranges for temperature and pressure of the air, strength and direction of the wind and certain other less important factors. The direction of fire is given to the guns, by laying them at the proper angle by compass or by reference to some object which can be seen by the gunners.

The computations required to lay guns correctly for range and direction are thus determined mathematically by a trained officer. He determines the direction and range, and the men at the guns do not in general see what they are firing at or know the results of their fire. They are themselves hidden from the enemy's view, to protect them from his fire.

When the enemy's guns can not be seen, but their flashes are visible, the range to these flashes can be determined by troops equipped for that purpose. These troops establish several stations, one or more miles apart, connected by wire to a central station. Each station is accurately located on the map. When the flash is seen each station observes the angle between a north and south line, and the direction to the flash. These angles are plotted at the central station,

and if correctly done the lines will cross at one spot, which thus determines the location of the hostile gun. The difficulty in practice is to have all stations observe the same flash. If there be but one, this is simple, but when there are many, it becomes impracticable.

Sound Ranging stations, located as for flash ranging stations, record sounds of a hostile gun through microphones. The distance to the gun firing is calculated, based upon differences in time, between the arrival of sounds from the same gun at each of the microphones. This system can not ordinarily be used if more than one gun is firing, as the microphones pick up all sounds, and it becomes impossible to decide which of the microphone records refer to the same gun. See also FIRE CONTROL.

C. H. L.

RANGOON, the principal port and capital of Burma, India, situated on the Rangoon River about 21 mi. from the sea in 16° 47' N. and 96° 13' E. Pop. 1921, 341,962; 1931, 400,415. Since the occupation by the British in 1852 Rangoon underwent many changes and the population increased sixfold. To-day it is the third seaport in India. Within the city is the Shwe Dagon or Golden Pagoda, one of the most sacred Buddhist temples, which is an object of pilgrimage from all parts of the Orient. A large and increasing commerce is carried on with Indian and Chinese ports and an extensive trade is conducted with inland towns as far as Mandalay. The chief exports are rice, timber, cotton, hides, gums, ivory and precious stones; the imports being mainly manufactured goods. The Japanese have acquired large rice milling interests at this port.

RANIER, MOUNT. See MOUNT RAINIER PARK.

RANKE, LEOPOLD VON (1795-1886), German historian, was born at Wiehe, Thuringia, Dec. 21, 1795. He was educated at Leipzig and studied theology and philology at Halle and Berlin. In 1825 he became a professor at the University of Berlin. From 1827-31 he was commissioned by the Prussian Government to study the archives of Vienna, Venice, Rome, and Florence and in 1841 was appointed historiographer of Prussia. Among his chief works are *Histories of the Romanic and Teutonic Peoples 1494-1535*, published in 1824; *The Popes of Rome, 1834-37* and *Universal History*, 1880-86. Ranke wrote with a clear perspective of the panorama of world history. Ranke was a pioneer in the introduction of the critical method in historical research and writing. He insisted on complete objectivity and urged his followers to concern themselves only with telling "how things actually were." He lived to be over 90 and was at work on his *Universal History* until within a few days of his death at Berlin, May 23, 1886.

RANKIN, JEANNETTE (1882-), first woman member of the U.S. Congress, was born on a ranch near Missoula, Mont., June 11, 1882. She graduated from the University of Montana in 1902 and in 1908-09 attended the New York School of Philanthropy. The next year she worked for the cause of woman suffrage in Washington State, and when the equal

suffrage amendment was submitted to Montana she campaigned throughout that state in 1912-14, speaking in mining camps and before the Legislature. In 1914 she became leader of the state suffrage organization. She was elected Republican Representative-at-large to Congress in 1916 and served one term. She was defeated as a candidate for the United States Senate in 1918.

RANKIN, a borough in Allegheny Co., in southwestern Pennsylvania, situated on the Monongahela River, about 9 mi. from Pittsburgh; it is served by three railroads. Rankin and the adjoining boroughs, Braddock and North Braddock, form one industrial community with steel as the leading interest. Pop. 1920, 7,301; 1930, 7,956.

RANUNCULUS, a large genus of herbs of the crowfoot family many of which are commonly called BUTTERCUP or CROWFOOT. There are about 300 species very widely distributed in temperate and cold regions; of these 100 or more are found in North America. A few are grown for their ornamental flowers; several are wide-spread as weeds. They are annual and perennial plants with erect, creeping, or sometimes aquatic and floating stems, bearing entire or variously divided leaves and often showy, mostly yellow or white flowers, either solitary or in clusters.

RAOULT, FRANÇOIS MARIE (1830-1901), French physical chemist, was born at Fournes-en-Veppes, Nord, May 10, 1830. Teaching chemistry at Sens in 1862, he obtained his doctor's degree in Paris in the same year, and was appointed professor of chemistry at Grenoble in 1870, becoming dean of the faculty of Sciences in 1889. He is principally remembered for his work on solutions, in which line of research he laid the foundations for much of what came after him by determining the changes brought about in the freezing and boiling points of solvents and their dependence upon the molecular weight of the solutes. He died at Grenoble, Apr. 1, 1901.

RAPALLO, a town of northwestern Italy; situated on the Gulf of Rapallo, about 20 mi. southeast of Genoa. Lace making, fishing, and trade in olive oil afford the chief occupations. Rapallo is a popular winter resort and the vicinity is dotted with handsome villas. The town has an interesting medieval bridge and a ruined castle. Nearby is the seaport, Portofino. Pop. 1931, 14,670.

RAPALLO, TREATY OF, Apr. 16, 1922, a compact signed by Germany and Soviet Russia at Rapallo, Italy. All of the former enemy and neutral countries of Europe had met, Apr. 10, in the Conference at Genoa to try to work out a new basis of economic and political relationship and, in particular, to devise a method for the renewal of relations between the Union of Russian Soviets and the other nations. The delegates of Germany and Russia at once began to hold secret meetings at Rapallo and there negotiated a treaty in which the two countries agreed to give up all claims on each other to war indemnities, to resume diplomatic relations, and to govern their economic relations

by mutual good will. The announcement of this treaty was received by the Conference at Genoa with surprise and indignation.

RAPE (*Brassica Napus*), an annual herb of the mustard family, closely allied to the cabbage and turnip, called also colza or coleseed. It is cultivated, especially in Europe, for its oil bearing seeds and as a forage and fodder plant. The plant grows 2 or 3 ft. high with branching stems bearing very smooth, deeply lobed leaves, light yellow flowers and a long slender beaked pod containing numerous small seeds, which yield 30 to 45% of oil. Rape is known only as a cultigen. See also OILS.

RAPE, unlawful carnal knowledge of a woman forcibly and against her will. Statutes have extended the crime to cover connection with females below the age or consent though consented to. A male under fourteen is held incapable of the offense.

RAPE OF THE LOCK, THE, a mock-heroic poem in five cantos by ALEXANDER POPE; published 1714. Shortly before this poem was written it happened that Lord Petre had stolen a lock of Miss Arabella Fermor's hair, thereby provoking that lady's wrath. Around this trivial incident Pope wrote probably the most brilliantly satirical poem in English. In devastating heroic couplets he described not only the feud between "Belinda" and the "Baron" but also the whole upper class society of his day, its manners, morals, dress and every foible. Light and sparkling, the poem is a masterpiece of 18th century writing.

RAPE OIL, a vegetable oil obtained from the seed of *Brassica Napus*, also called Colza, the French corruption of the Dutch, Koolzaad (cole seed), a winter growing plant, closely akin to the turnip. Rape oil is a non-drying oil, used extensively for lubricating purposes, in lamps, and, in the East Indies, as a food. The purified oil, clear yellow in color, and sweetened in taste by heating with starch, is used as a salad oil in Germany. After the oil has been extracted, the seeds are pressed into cakes which form a valuable cattle feed.

RAPHAEL (from the Hebrew for God heals), an archangel mentioned in the Book of Tobit 12:15 and in the Book of Enoch 20 and 100. In later rabbinical commentaries Raphael appears as the angel who revealed to man the secrets of healing, or medicine.

RAPHAEL SANZIO (1483-1520), Italian painter, was born at Urbino, Apr. 6, 1483. Among the incontestably great painters of the world Raphael Sanzio is easily the most romantic figure. His career reads like the invention of a poet. He was handsome, sweet-tempered and universally beloved. He was an undeniable genius, achieved success upon his first appearance and died young, deeply mourned by the cardinals, princes and other great people with whom he had begun to live upon equal terms.

He was thought precocious by some writers because at the age of 20 he was already producing excellent pictures but precocitv is not the word for a young artist whose father before him was an artist. Raphael merely grew up in an artistic atmosphere and with

everything to aid him to an early start. His gentle disposition invited others to help him, and in his history there is none of the strife so frequently met with in the records of other artists of the time. The dukes of Urbino, his native town, were invariably kind to him and gave him access to their collections where his taste was formed. Taste, it might be said, was his guiding force. He developed an eclectic habit and formed his manner upon all the best models, though his first instructor, Perugino, had the dominating influence at the beginning. So many different "periods" in an artist who died so young—at the age of 37—is astonishing but not in itself a virtue so much admired now as it used to be.

With such an angelic character it is natural to find Raphael excelling all others in the painting of Madonnas. He became a finished draughtsman and a superb painter and finally a great mural decorator, but the world at large still pins his fame to his Madonnas. These are distinguished by a sweet serenity and purity that realize the finest imaginable conceptions of the young Mother of Christ. Among those that have been worshipped by the entire world may be listed the *Madonna della Seddia*, in the Pitti Palace, Florence, where is also the *Madonna del Granduca*; *Madonna del Cardelli Cardellino*, Uffizi Gallery, Florence; *La bella Giardiera*, Louvre, Paris; *Andidei Madonna* and *Ansidei Madonna*, National Gallery, London; *Madonna di San Sisto*, in Dresden; *Madonna of Foligno*, in the Vatican; and the *Madonna della Rosa*, Madrid. Among additional paintings are the *Entombment*, in the Galleria Borghese, Rome; *St. Michael and the Devil*, Louvre; *Coronation of the Virgin*, Vatican, and the *St. Catherine*, National Gallery, London. Raphael painted but few portraits but those he did are very great. Probably the most famous are the *Baldassare Castiglione*, in the Louvre, and the *Angelo Doni*, Pitti Palace.

But there are not lacking critics who find their chief interest in Raphael's celebrated mural paintings in the Vatican, preferring them to the *Transfiguration* which was once thought to be the greatest picture in the world. The *Disputa*, the *School of Athens*, *Mount Parnassus*, *Mass at Bolsena* and the *St. Peter Freed from Prison* are certainly priceless contributions to art. They have every grace in composition, every felicity in painting and in addition exhibit a vast acquaintance with philosophy and history. If Raphael's talent were heaven-born, then it is clear he worked prodigiously to perfect it. The painter died of a fever at Rome, Apr. 6, 1520. H. McB.

BIBLIOGRAPHY.—Vasari, *Lives of the Painters*; J. A. Crowe and G. B. Cavalcaselle, *Life and Works of Raphael*, 1882-85; Venturi, *Raffaello*, 1920.

RAPID CITY, a city in southwestern South Dakota, the seat of Pennington Co. It is situated on the Rapid River, at the foot of the Black Hills. Three railroads serve the city which is the center for the surrounding farming and mining districts, the latter producing gold, silver and other metals. The city has various factories and packing-houses. The

RAPHAEL SANZIO



"THE MADONNA OF THE CHAIR" (*Madonna della Sedia*)

By Raphael or Raffaello Sanzio (1483-1520), now in the Pitti Gallery, Florence.

retail trade in 1929 reached a total of \$9,548,924. It is the seat of the State School of Mines and a Government Indian school. About 30 mi. south is Custer State Park, a refuge for elk, buffalo and other game. Toward the southeast are the Bad Lands. Rapid City was settled in 1876 and incorporated in 1878. Pop. 1920, 5,777; 1930, 10,404.

RAPPORT, a feeling of close sympathetic relation between the hypnotiser (*see* HYPNOTISM) and his subject. The term is also used more generally for relations of sympathy leading to understanding as between doctor and patient, husband and wife, friend and friend.

RAPS, sounds credited to spirits of the dead and associated with haunted houses and the doings of POLTERGEISTS. Raps were converted into a code of communication by spiritualists (1849) by agreeing that one rap would mean "yes" and two "no" in answer to questions addressed to spirits. In table rapping the movements of the table, with the sitters' hands upon it, produced the raps. *See* SPIRITUALISM; TABLE TURNING.

RARE EARTHS, the name given in inorganic chemistry to a group of metals belonging to the same division of the PERIODIC SYSTEM as Aluminum, and deriving their group name from the resemblance to this well-known earth-element. Among themselves the rare earths are so similar in their chemical properties that the problem of separating them, and isolating the compounds of each element individually presents the greatest difficulties. In nature they practically always occur together in such minerals as gadolinite, euxenite, fergusonite, samarskite, cerite and monazite, and although some of them are indeed exceedingly rare in nature, and occur only in the minutest quantities, others, notably cerium, neodymium, and lanthanum, are fairly common. The recent researches on atomic structure and the periodic system of the elements have shown that no more rare earths can exist beyond those now known, which number 15, bear the consecutive atomic numbers from 57 to 71, and have atomic weights varying from 139 to 175. They are trivalent and produce oxides of the form M_2O_3 , with the exception of Cerium which may be tetravalent, and really belongs to the same group in the periodic system as Thorium. The elements Scandium and Yttrium, of atomic numbers 21 and 39 respectively, though not actually belonging to the group, are often considered with it because of their very similar chemical behavior, especially the latter. Historically the rare earths may be divided into two subgroups, those obtained from Yttrium ores, comprising Terbium, Erbium, Gadolinium, Holmium, Dysprosium, Ytterbium, Thulium, Lutecium, Yttrium, and Scandium, and the Cerium group comprising Cerium, Lanthanum, Praseodymium, Neodymium, Samarium, and Europium. Among the chief minerals yielding these elements are allanite, cerite, euxenite, fergusonite, MONOZITE and SAMARSKITE. These minerals are found mainly in the United States, Norway, Brazil, India and Australia. The principal data concerning the 17 elements are given in the following table.

ATOMIC NUMBER	NAME	SYMBOL	ATOMIC WEIGHT	MELTING POINT CENT
21	Scandium	Sc	45.1	
39	Yttrium	Y	89.0	1250
57	Lanthanum	La	138.9	810
58	Cerium	Ce	140.2	623
59	Praseodymium	Pr	140.9	940
60	Neodymium	Nd	144.3	840
61	Illium	Il	147.0 ²	
62	Samarium	Sm	150.4	1350
63	Europium	Eu	152.0	
64	Gadolinium	Gd	157.3	
65	Terbium	Tb	159.2	
66	Dysprosium	Dy	162.5	
67	Holmium	Ho	163.5	
68	Erbium	Er	167.7	1250
69	Thulium	Tm	169.4	
70	Ytterbium	Yb	173.5	1800
71	Lutecium	Lu	175.0	

W. J. L.

RARE GASES, that group of chemical elements characterized by almost complete chemical inactivity. All but one of them are constituents of our atmosphere. Although the researches of Cavendish in 1785 foreshadowed the existence of Argon, and the presence of Helium in the sun had been proved in 1868, without, however, indicating anything about the properties of this substance, the discovery on earth of these elements dates from 1894. In that year Rayleigh and Ramsay, starting from the discordant fact that nitrogen obtained from the air was invariably $\frac{1}{2}\%$ heavier than chemically pure nitrogen prepared from nitrogenous compounds, subjected atmospheric air to a rigorous analysis. After all known gases had been eliminated, the remainder constituting about 1% of the original air, was found to be a gas completely inactive chemically speaking, and was therefore named Argon, Greek for "inert." Subsequently the residue was found to contain still other, similar gases, which could be separated by fractional distillation, viz., Helium, so named because it was first found on the sun; Neon, "the new one"; Krypton "the hidden one," and Xenon, "the foreign one." The radium emanation, discovered in 1900, is known as Radon.

The first five of these are found in the atmosphere, helium, neon and argon in the percentages, 0.0005, 0.0018 and 0.93 respectively; the percentages of krypton and xenon are less and are estimated to be about 0.0001 and 0.00006 respectively.

The rare gases occupy a singular position in chemistry in that—with the possible exception of Helium—they are completely inert, and unable to combine with other elements. The modern developments of atomic theories have shown this to be due to the fact that the structure of their atoms is as symmetrical as possible with all the different "shells" of electrons circling around the nucleus complete, leaving no room for any further affinity toward other elements. Probably for the same reason the molecules of these gases comprise only one atom, instead of two, as is the case with the ordinary gases such as hydrogen, oxygen, and nitrogen. The more important physical and chemical

data concerning these six peculiar elements are set forth in the table.

NAME	SYMBOL	ATOMIC NUMBER	ATOMIC WEIGHT	BOILING POINT CENT	MELTING POINT CENT
Helium	He	2	4.00	-268.5	-270.0
Neon	Ne	10	20.2	-210.0	
Argon	A	18	39.91	-187.0	-189.6
Krypton	Kr	36	82.9	-152.0	-169.0
Xenon	Xe	54	130.2	-109.1	-140.0
Radon	Rn	86	222	-70.0	

W. J. L.

RASHI (1040-1105), (an abbreviation formed from the first letters of the words of his Hebrew name, Rabbi Solomon (ben) Isaac, or Rabbi Shelomoh Yitzhaki), the greatest and most popular Jewish commentator on the Bible and Talmud, was born in Troyes, Northern France, in 1040. He was distinguished by his modesty, simplicity, piety and nobility of life and character. When still a young man he studied in the German rabbinical academies at Worms and Mayence; his Worms associations have been perpetuated through the erection of a memorial Rashi chapel near the wall of the synagogue there. When he was only 25 years old he established a school at Troyes, which became one of the greatest and most famous centers of Jewish learning in all Europe. Rashi refused to accept pay from his pupils, but supported his family by making wine and through agriculture. He had three daughters but no sons. One of his daughters, Jochebed, had three sons, Samuel ben Meir (Rashbam), Isaac ben Meir (Ribam), and JACOB BEN MEIR TAM. These three famous grandsons of Rashi founded the school of the Tosafists. Rashi died at Troyes in 1105.

Rashi wrote a running commentary on practically the entire Bible (Old Testament), with the exception of Ezra, Nehemiah, Chronicles, and parts of Ezekiel and Job; and on almost the entire Babylonian Talmud. His writings, despite his profound erudition, were so simple, homely and intelligible that they were beloved by the common people. His diction was so concise, simple and pure that his numerous pupils declared that had it not been for him, the extremely difficult Talmud, most of which was composed in Aramaic, would have always remained a closed book to all except scholars. The Franciscan monk Nicholas de Lyra praised Rashi's commentaries very highly as models of simple and lucid exegesis. In all his commentaries Rashi was not concerned with new ideas, but merely with the clear expression of the traditional teachings and doctrines. An interesting feature in his writings is the fact that he gives the Old French (Belaaz) translation of more than 3,000 Biblical and Talmudic terms. His work thus represents a veritable treasure trove for the study of Old French vocabulary and the evolution of the present French language. Rashi's commentary on the Pentateuch was always, and still is, used as a text-book in

Jewish schools and academies, and was even translated into German, English and Latin. A. SH.

BIBLIOGRAPHY—Liber, *Rashi*, 1908, Max Schlessinger, *Rashi*, 1908, Graetz, *History of the Jews*, 1926.

RASPBERRY, the juicy edible fruit of several brambly shrubs of the rose family closely allied to the blackberry. The fruit, commonly called a berry, is really an aggregate of many drupelets, which, unlike those of the blackberry, readily separate from the receptacle when ripe, clinging together in the form of a cap, whence the name blackcap or redcap. The numerous varieties of cultivated raspberries form four groups derived chiefly from (1) the European red raspberry (*Rubus idaeus*), (2) the American red raspberry (*R. idaeus* var. *strigosus*), (3) the American black raspberry (*R. occidentalis*) and (4) the purple raspberry (*R. neglectus*), a hybrid of the American black and red raspberries.

The European red raspberry, native to Europe, Asia and some parts of North America, was well known to the ancient Greeks. It is the parent wild species which in cultivation has given rise to the garden red raspberries of the Old World, some of which, as the Red Antwerp, have been sparingly cultivated in America. There are yellow and white varieties. The similar but harder American red raspberry, which grows widely in North America, is the source of most of the red and golden raspberries cultivated in the United States and Canada.

The black raspberry, found wild in many parts of North America and introduced into cultivation in 1832, has become an important bush fruit ranking next to the strawberry among the small fruits marketed in the United States. The purple raspberries, called also purple canes, sometimes occur wild. In cultivation they have given rise to the Columbian and other raspberries with firm, large, purplish fruit.

The loganberry (*R. loganobaccus*) is believed to be a hybrid of the American red raspberry and the western blackberry (*R. ursinus*). A. B. J.

Cultivation. Raspberries have perennial roots and usually erect biennial stems which normally bear fruit during their second summer but die before the second spring. So in cultivation old stems are cut out at the end of the fruiting season. The red (and white) cap varieties develop shoots at unexpected points so that without attentive pruning they may form thickets. Black cap kinds produce new stems around the original plant in a stool or hill. However, as the young shoots when bent to the ground form new plants by taking root at their tips, the blackcaps, too, will form thickets. To prevent this the tips of young shoots are pinched (not cut) off when they are about 30 inches tall. This causes the stems to become stocky and branchy. New plants are obtained by allowing the stem tips to take root. The purple cane kinds may follow either of these methods, depending upon the preponderance of the red or the black parentage.

Because of these characteristic differences red raspberries are generally grown in continuous rows, the stems 6 to 12 inches apart and cultivated after the

first season in only one direction. The blacks are usually planted in squares 5 or 6 feet apart each way and, because of their stooling nature, cultivated in two directions.

Raspberries thrive best in well drained but moist loams rich in humus. The plants are set as early as possible in spring to take advantage of soil moisture. They must have clean cultivation. During the first season usually no fruit is developed; during the second, only a partial crop; but from the third to the sixth season full crops are borne. The yield in size, quantity and quality of the berries then declines. *See also* BLACKBERRY; LOGANBERRY; RUBUS. M. G. K.

RASPS. *See* FILES AND RASPS.

RASPUTIN, GREGORY EFIMOVITCH (1871-1916), Russian monk adventurer, was born in the village of Pokrovskve, in the province of Tobolsk, Siberia. The son of a poor peasant, he grew up without education and remained in his native village until he was 33. Though he married a well-to-do girl and had three children his conduct was such as to earn him the name of Rasputin, which means the debauche.

In 1904 he left his family, became addicted to superstitious religious exaltation and took up with the "Klysty." This sect taught that repentance is necessary to salvation, which he interpreted "sin in order that you may obtain repentance." This theory he practiced in wild orgies which attracted much attention. He also made long pilgrimages and spent considerable time in different monasteries. In spite of his ignorance and bad manners, his strong physique, undoubted magnetic power and even his licentious behaviour, made him a great social success. He became a welcome guest in some of the most fashionable homes, and even in the Imperial palace. When presented at Court in 1907 he deeply impressed the Tzar and Tzarina and soon acquired power over the latter through his supposedly benign influence upon the health of her afflicted son, the Grand Duke Alexis.

As he became more strongly entrenched in favor, Rasputin began to dictate in Church affairs and to interfere in political matters, where he was a tool of the worst reactionaries. Such ignorant and dangerous procedure, together with his scandalous debauchery, led to an attempt to assassinate him in 1914 and finally to his death in Dec. 1916 at the hands of Prince Yussupoff and others of high social position. The Tzarina had him buried in the park at Tsarskoe Selo in a special chapel erected for him. A. L. L.

RASSELAS, an allegorical romance by SAMUEL JOHNSON; published 1759. This is the fable of Rasselas, Prince of Abyssinia, who, escaping from the "Happy Valley" in which he has been confined, goes forth to the outside world, accompanied by his sister, Nekayah, and a poet, Imlac, seeking everywhere the happiest condition of human life, only to return at last, disillusioned, to his mountainous paradise. The book, said to have been written in a single week, contains some of the finest of Dr. Johnson's prose.

RAT, a large rodent of the genus *Rattus*, particularly the black rat (*Rattus rattus*) and the brown rat (*Rattus norvegicus*). Both these species are natives of central Asia, but since they infest ships have been carried to nearly all parts of the world. The black rat entered Europe in the 13th century, the brown or Norway rat about 1728. In England the black rat is now almost exterminated, in North America, where it came first, it has been steadily driven westward and northward by the fiercer brown rat.

Both animals are exceedingly intelligent, with keen sight and acute sense of smell. The black rat averages 7½ in., excluding its long tail, while the shorter-tailed brown rat measures 10½ in., has a less sharply pointed muzzle, and shorter, lighter hair. Both are enormously prolific, breeding several times a year, bearing 10 or more young at a time. It is estimated that the omnivorous brown rats destroy \$100,000,000 worth of food-stuffs annually in the United States. They eat eggs, poultry and even game birds. With their strong teeth they gnaw through hard wood and even lead pipes.

The spread of bubonic plague has been traced directly to rats and the United States Government guards all seaports to prevent rats from leaving incoming ships. The plague bacillus is spread by fleas which infest the rat.

RATCHET AND PALL, a mechanism attached to mechanical devices to permit motion in one direction only. The ratchet is either a straight or a circular member with inclined "V"-shaped teeth, and the pall is a tooth so pivoted that it engages in these teeth when the ratchet starts to move in the reverse direction.

RATEL (*Mellivora*), the name given to three related mammals resembling badgers in size and appearance and belonging to the same family as otters and skunks. The Indian ratel is found throughout India, the Cape ratel ranges over Africa, and the black ratel is native to the Ituri forest. Like the skunks, ratels possess glands for secreting an odorous liquid for defense. In burrowing they surpass the skunk. They are about 2 ft. long, the tail measures about 5 in. The Cape ratel feeds much on bees and their honey; the Indian ratel, while carnivorous, also enjoys honey. Ratels are easily tamed and make amusing, sportive pets.

RATE SETTING. The hourly wage of the least skilled employee is the fundamental base rate of an industrial payroll. Usually it is determined by the law of SUPPLY AND DEMAND. In general a base rate is the hourly wage for any class of individual job, and its relation to the fundamental one is governed by such variable factors as skill, hazard, and responsibility. The whole economic fabric affects all rates so that they vary between countries, localities in a single country, sexes, ages and slightly between similar plants. COLLECTIVE BARGAINING also affects base rates and sometimes causes wide differentials. Cost of living, sliding price scales and value of the dollar indices are occasionally used as guides in determining adjustments. Job classification based on experience and

analysis is, however, the best means of setting rates, but they must be tested by results and are never stabilized for long.

C. W. L.

BIBLIOGRAPHY.—C. W. Lytle, *Wage Incentive Methods*, 1929.

RATIBOR, a German city in the Prussian Province of Silesia, situated on the Oder, where the shipping begins. It is about 100 mi. southeast of Breslau. The city is a busy industrial center with machine factories, foundries, manufactures of iron ware, cork, chemicals, glue and other commodities. The trade is chiefly in coal, skins, lumber, snuff, wine and farm products. Pop. 49,072.

RATIFICATIONS OF TREATIES, the formal act by which an appropriate legislative body gives its approval to a treaty or convention negotiated and signed by the executive or his agents, and submitted in due course to the ratifying authority. Treaties in the United States are made by the President with the advice and consent of the Senate. This body early established its right to separate and independent judgment in the matter of giving its advice and consent. This has become, not a counselling function for the benefit of the President, but a distinct step in treaty-making, known in international law as ratification. The Senate gives its advice and consent by means of a two-thirds vote of the Senators present when the vote is taken in favor of a resolution of ratification. The Senate may amend the provisions of a treaty by majority vote. Such amendments must be submitted to the other party for approval. Moreover, the Senate may expressly reject a treaty or it may merely refuse its advice and consent.

C. E. Ma.

RATIO, a term usually employed at present to denote the relation of one number to another as indicated by the quotient of the former divided by the latter. The division is indicated by the fractional form, as in $\frac{3}{4}$, or by the use of the colon, 3:4, or the solidus, $3/4$. A ratio of this nature is sometimes called a geometric ratio. If a and b are incommensurable, i.e., if no common measure exists for them, the ratio $a:b$ is an irrational number. The difference between two adjacent members in an arithmetic progression was formerly called an arithmetic ratio. Thus in 9, 7, 5, 3, 1, we have $9-7=2$, the arithmetic ratio, the term still being occasionally used for the common difference. In elementary arithmetic it is asserted that the two numbers must relate to the same unit (3 ft.:4 ft., but not 3 ft. to 48 in.), but in practical and scientific work we frequently speak of the ratio of the distance to the time. In general, however, the ratio is considered an abstract number. In the Middle Ages the word proportion (*proportio*) was used for ratio, and proportionality (*proportionalitas*) for proportion, and this usage is still continued, as when we say, "divide this in the proportion of 2 to 3," or, less commonly, "the proportionality of the cost is the same as that of the amount." As examples of ratio, $4:8 = \frac{1}{2}$, $\frac{1}{4}:\frac{1}{8} = 2$, $2\sqrt{3}:3\sqrt{3} = \frac{2}{3}$. See PROPORTION; ANHARMONIC RATIO.

RATION, allowance of food for one person or one animal, for one day. U.S. Army rations for troops are 1. Garrison ration, for peace time use in permanent garrison or camp. Its listed items of essential foods may be used by troop messes or their current market values may be applied to purchase of other kinds, provided the soldiers are properly subsisted. 2. Filipino ration, for Philippine Scouts. Its kind, number of items and quantities of allowance, are such as to accord with the taste and dietetic requirements of the native Filipino. 3. Travel ration, for soldiers traveling otherwise than by marching and separated from army cooking facilities. It is issued in kind with money allowance in cash for purchase of coffee en route. 4. Field ration, for use in actual or simulated warfare. Is issued in kind and approximates the garrison ration. 5. Reserve ration, for emergency use. Consists of prescribed basic and nutritious articles, packaged to effect economy of space and weight when carried in the soldier's pack. 6. Hospital ration, for enlisted men in hospitals, is commuted on the basis of the value of the garrison ration plus an additional and prescribed percentage, such total being in consideration of higher cost for special foods and cost of operating a hospital mess.

United States Army ration for animals is prescribed in allowances for horses, proportioned, by given quantities, according to weight classification of the animal, and under a specific allowance for mules, and considering whether the animals are in garrison or in field service.

The U.S. Navy ration was instituted by an Act of Congress in 1862, and the food component parts named. From time to time, these constituent parts of the ration have been changed. The monetary cost of the ration therefore changes; but in commuting rations, a specific sum of money is always named. Special conditions of rations allowed on small craft and men in hospitals are made subjects of legislation. The ration is not part of pay.

J. L. D.-R. E. C.

RATIONALISM, a philosophic position holding that the ultimate criteria for knowledge must be derived from reason. Knowledge must start with principles derived from reason and must in the final analysis be corroborated by reason. It is thus the opposite of **EMPIRICISM**. It may also take other forms, such as rationalism in ethics or the rationalism of the French Enlightenment. In ethics it becomes a phase of intuitionism, while during the Enlightenment of the 18th century the emphasis was on checking customs and institutions by appeal to reason and developing and distributing rational ideas throughout society, rather than on problems of knowledge as such.

Rationalism in modern philosophy was formulated by **RENÉ DESCARTES**, systematized by **BARUCH SPINOZA**, developed by **WILHELM GOTTFRIED LEIBNITZ**, and carried to its culmination by **Wolff**. It was essentially a Continental school in contrast to the British empirical school. It sought to find a starting point for knowledge that would be safe, i.e., something that could not be questioned, something so axiomatic that

it must be accepted by all reasoning beings. From such a starting point it then proceeded deductively to build up its structure. Thus Descartes, after doubting everything but his own existence, was able to reach a belief in both God and the world by arguing to the existence of God from his own existence, and to the reality of the world because of the existence of God. Spinoza worked out his *Ethics* according to the method of geometry, and it was Wolff's dogmatic rationalism that helped to stimulate Kant's (see KANT, IMMANUEL) critical philosophy.

RATIONALIZATION OF INDUSTRY, a comprehensive term used to denote the newer industrialism which endeavors to simplify, standardize and stabilize industry according to modern conditions of greatly increased productive capacity. The term rationalism is used only in Europe, where, during the World War, the necessity for increased production despite lack of capital, made improved technical methods and scientific distribution of products imperative. Its objects are accomplished abroad by combinations to reduce competition and to control raw materials, labor, products and prices. Such combinations are often international and in Germany are known as cartels. Although not called rationalization in the United States, the basic idea of a systematic and scientific organization and direction of enterprise has gained wide acceptance in this country and the elimination of industrial waste and inefficiency by the application of scientific principles to business enterprise have been recognized by the United States Supreme Court. The gospel of free competition as a regulator of the kind, quality and quantity of goods produced and the prices thereof has lost weight in the complex and highly developed situation of industry existing today.

Competition for the buying power of the world public is the object of modern basic industries. Experience has shown industrial leaders that large scale production with reduced unit costs leads to survival. But increased production may go far beyond the absorptive power of the market, resulting in harmful fluctuations of quality and quantity of production, prosperity and employment. In such circumstances industrial leaders seek by combination to establish regulation of the field in which they operate. Free competition is sometimes accompanied by waste which imposes hardship on a struggling industry or even upon a nation. Under general prosperity or in a country exceptionally rich in natural resources such wastes may be borne. But when the margin of profit is small and the cost of competition cannot be added to the market price the combination movement develops. The economies of large organizations are readily apparent. Cross freights are avoided, plants may be run at full capacity and some may be shut down so that they may be operated at an even load, and laboratories and INDUSTRIAL RESEARCH departments may be maintained economically by spreading the expense over a large output. Supplies of raw materials may be owned or controlled by the com-

bined industry. Germany has progressed toward rationalization faster than the United States where combinations are directly opposed to the policy of the nation. In all foreign countries the governments are more tolerant toward industrial coordination. In no European country are there legal provisions which embody the regulations and drastic penalties of the United States antitrust laws (see ANTITRUST LEGISLATION). The existence of rationalization and combination in Europe is regarded by European economists as the beginning of a movement which is destined to replace to a great extent in the economies of nations the politico-economic arrangements of the World War period such as tariffs and commercial treaties. The fundamental trend toward international combines is the natural and inevitable outcome of the movement towards concentration and national combination in general. The mobilization of industry during the war was the germinating factor in the formation of domestic cartels which led later to international combinations and complete rationalization.

RATIONAL NUMBERS, positive and negative integers, and common fractions with integral terms. Numbers involving roots, such as $\sqrt[3]{7}$, $\sqrt{2}$, and $\sqrt[4]{7}$ are called irrational numbers. See ROOT; TRANSCENDENTAL NUMBERS; IMAGINARY NUMBERS.

RATISBON or **REGENSBURG**, a Bavarian city on the Danube, about 106 mi. north and east of Munich. At one time it was a free imperial city and the seat of the German Reichstag. It has narrow, winding streets, among them the Ambassadors' Street, in which the houses are still marked with the coats of arms of the representatives who occupied them. Among the churches are St. Peter's Cathedral, begun in 1275, the foremost Gothic church in Bavaria; St. Stephen's Chapel, 11th century; the collegiate church, Obermunster, 11th century, and St. James's and St. Leonhard's of the 12th century. There is a fine old rathaus, where the sessions of the Reichstag were held from 1645 to 1806; the palace of the Prince of Thurn and Taxis; the former Benedictine Abbey of St. Emmeran, with a church of the 11th and 12th centuries; and many early medieval patrician houses with defensive towers. The city produces metal goods and machines, has lime kilns, sawmills and many minor industries. It deals in grain, oil and lumber, and has a transit trade. A Slavic settlement in prehistoric times, it was fortified by Marcus Aurelius and later devastated. About 700, it was capital of the duchies of Bavaria and of a bishop, in 826 it was the residence of the eastern Frankish Carolingians. The stone bridge across the Danube is one of the most famous medieval constructions, built in 1135-46. Ratisbon is an important center of early medieval art. The Prehistoric-Roman Museum and the medieval Lapidarium are among the most noteworthy in Germany. Pop. 1925, 76,948.

RATKE, or **RATICHIUS**, **WOLFGANG** (1571-1635), educational reformer, was born at Wilster in Holstein, Oct. 18, 1571. He was educated at the Hamburg Johanneum and the University of Rostock.

Ratke devised a rapid method for teaching languages based on the Baconian theory of induction, which was tried out at Amsterdam, Strasbourg, Frankfort and various other places. His work was overshadowed by that of JOHN AMOS COMENIUS. He died at Erfurt, Apr. 27, 1635.

RATON, a city in northeastern New Mexico, the county seat of Colfax Co., situated at the base of the Sangre de Cristo Mountains at an altitude of 6,666 ft. Trinidad, Colo., is 26 mi. north. Bus lines and the Santa Fé Railroad serve Raton. It is in the important mining region of New Mexico; coal and gold are the chief products. Grain is grown in the vicinity which is irrigated by the Eagle Nest Dam project, 60 mi. southwest. Raton, formerly a station on the old Santa Fé Stage Coach trail, is now a trade and tourist center. Southeast is El Capulin, an extinct volcano. Taos, an Indian pueblo and artists' colony, is 96 mi. southwest over the Sangre de Cristo Mountains. Raton was founded in 1879 and incorporated in 1897. Pop. 1920, 5,544; 1930, 6,090.

RATNSNAKE, a common name which may be given to any snake that lives largely on rats. In the United States it is generally applied to large colubers such as the yellow rat or CHICKEN SNAKE and the gray rat or spotted chicken snake (*Coluber obsoletus confinis*). Another genus (*Spilotes*) of American rattsnakes occurs mainly in South America and the West Indies, but one species, the GOPHER SNAKE, lives in the United States. A third genus of ratsnakes (*Ptyas*) is found in India.

RATTLEBOX, a large genus (*Crotalaria*) of herbs and shrubs of the pea family, the seeds of which at maturity loosen and rattle in the membranous inflated pods. There are about 250 species, most numerous in Asia; a few are grown for ornament chiefly in California and Florida. The erect stems bear mostly simple leaves and pealike, often showy, yellow, blue or purplish flowers, usually in clusters. Nine species are found in the eastern and southern United States.

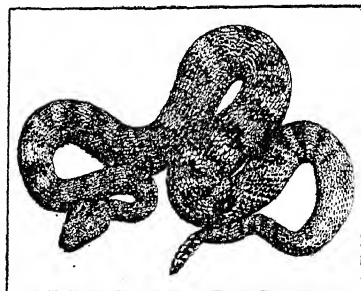
RATTLER TESTS. See ROCK TESTS; BRICK TESTS; CONCRETE TESTS; also PAVING BRICK.

RATTLESNAKE, the popular name for members of two genera (*Crotalus* and *Sistrurus*) of pit vipers. Most rattlers are natives of the United States, and only one species extends into South America. The rattle is developed from a scale which covers the tail-tip. When the snake molts this terminal scale is not shed; another scale develops, however, and becomes dovetailed into the old one. The age of the snake cannot be judged by the number of joints in the rattle, because there may be several molts a year, and, as the end joints are almost certain to be broken off from time to time, the number of molts cannot be told from them.

The majority of rattlesnakes are described by those who know them best as timid and retiring animals. When danger threatens they either seek to escape, or coil themselves and rapidly vibrate their tails, which

produce a loud whirring noise, as a warning. If, after this warning, one seeks to approach them, the results are likely to be fatal, for they are provided with the most virulent poison of any North American venomous snake.

There are 15 species of rattlesnakes. The largest is the diamond rattlesnake (*Crotalus adamanteus*) sometimes over 8 ft. long. It is olive or brownish in color, and ornamented with a design of large, darker, diamond-shaped marks, bordered with yellow. This species is found in the Southeast from the Mississippi, to North Carolina. Ten species are restricted to the



DESERT RATTLESNAKE

Southwest and Mexico. Among them is the western diamond or Texas rattlesnake (*Crotalus atrox*), which may be 7 ft. long. It is lighter in color than the eastern species. Two species, the Pacific rattlesnake (*Crotalus oregonus*) and the northern massasauga (*Sistrurus catenatus*) extend into Canada. In the East a species which was formerly common from New England to Florida, is the timber rattlesnake (*Crotalus horridus*), which may be 5 ft. in length. It is yellowish or nearly black, and marked by dark, irregular bands. A. I. W.

RATTLESNAKE FERN (*Botrychium virginianum*), a handsome fern of the adder's-tongue family called also Virginia grape fern. It is native to rich woods from Labrador to British Columbia and southward to Mexico, and is found also in Europe and Asia. The stout erect rootstock gives rise to long-stalked leaves, sometimes 2½ ft. in length, composed of a broad green sterile blade, deeply cut into numerous divisions, and a pinnately divided fertile portion bearing very numerous grapelike sporanges. See also MOONWORT.

RATTLESNAKE PLANTAIN, a genus (*Epipactis*) of orchids bearing basal leaves which are often blotched and veined with white, fancied to resemble the skin of the rattlesnake. Four species occur in North America, growing in woods chiefly in the northern United States and Canada. They are mostly low, slightly hairy plants with small greenish-white flowers in narrow one-sided leafy bracted spikes.

RATTLESNAKE WEED, the name given to various North American plants because of their reputed efficacy as antidotes for snakebites or on account of colored markings on the leaves suggestive of those on a snake's skin. Among the former are the button snakeroot (*Eryngium yuccifolium*), of the eastern

United States, and the dwarf carrot (*Daucus pusillus*), the *yerba del vibora* of the Spanish Californians, found in the southern and western states. Examples of those with foliar marking are the veined hawkweed (*Hieracium venosum*), of the eastern states, and the white-margined spurge (*Euphorbia albomarginata*), of the southwest.

RAU, KARL HEINRICH (1792-1870), German political economist, was born at Erlangen, Nov. 29, 1792. He held the chair of political economy at Erlangen and later at Heidelberg. Rau entered the First Chamber of the Duchy of Baden in 1833, was made a privy councillor in 1845 and three years later was elected to the Frankfurt preliminary parliament. His principal work is *Lehrbuch der Politischen Ökonomie*, an encyclopaedia of economics. Rau died at Heidelberg, Mar. 18, 1870.

RAVEL, MAURICE (1875-), French music composer, was born at Ciboure, Basses-Pyrénées, Mar. 7, 1875. He was educated under Gabriel Faure at the Paris Conservatoire, and in 1902 began to attract favorable notice to his piano compositions, which include *Mignonne*, *Ma Mère l'Oye*, and *Valses nobles et sentimentales*. Ravel has been classed as a "romantic modern"; his idiom is fresh and his ideas often unique, but his mode of expression is in the classical tradition. His one-act opera, *L'Heure Espagnole*, was produced in 1921 by the Chicago Civic Opera Co., and in 1928 by the Metropolitan Opera, New York.

RAVEN, a species of CROW, the largest of all passerine birds, found widely in various forms in the Northern Hemisphere. The Old World raven (*Corvus corax*), of Europe and northern Asia, is somewhat over 2 ft. long with a wing spread of 3 ft., and has deep black plumage glossed with purple and steel blue. Moving singly or in pairs, it frequents rocky regions or open country, building in trees or on cliffs a bulky nest in which it lays 4 to 6 brown-spotted, bluish-green eggs. Though practically omnivorous, feeding upon insects, eggs, nestlings and even attacking wounded animals, it subsists, however, largely upon carrion. Its ordinary note is a deep hoarse croak. The raven is highly intelligent, is easily tamed, and can be taught to speak a few words. Since ancient times it has been an object of veneration and superstition. The Roman augurs claimed to be able to predict the future from its manner of flight, while in both Greece and Italy it was sacred to Apollo.

The North American forms include the similar northern raven (*C. c. principalis*), found in Alaska and Canada but rare and local in the eastern United States, and the American raven (*C. c. americanus*), ranging throughout the western United States to Mexico, southward to Honduras. The much smaller white-necked raven (*C. cryptoleucus*), about 20 in. long, occurs chiefly in the southwestern states and central Mexico.

A. B. J.

RAVENNA, a city and archiepiscopal see in northeastern Italy, capital of the province of the same name, about 6 mi. from the Adriatic, with which it is connected by a canal. In its basilica and ornamental

mosaics Ravenna furnishes interesting evidence of the transition from early Christian to medieval art. Noteworthy structures are the cathedral, an early basilica rebuilt in the 18th century, containing a bishop's throne of ivory; the ancient baptistery dating from the 5th century; the Church of San Vitale with fine Byzantine mosaics; San Francesco, built 450, containing the grave of Archbishop Liberius (d. 350); and the Church of Sant' Apollinare Nuovo.

After the break-up of the Western Empire, Ravenna was the residence of the Ostrogothic kings until 539, then for two centuries of the Byzantine exarchs. Towards the end of the 13th century, having been ruled by the Popes, it came under the power of the Polenta family. Venice controlled the city from 1441-1509; until 1860 it belonged to the States of the Church.

In the modern city there are many schools and academies, as well as a library containing thousands of books on DANTE, whose tomb is here. The chief occupations of the inhabitants are sulphur refining, tanning, printing, and the manufacture of glassware. Pop. 1931, 78,143.

RAVENNA, a city in northeastern Ohio, the county seat of Portage Co., situated 35 mi. southeast of Cleveland and served by three railroads. The region produces maple syrup, grain, wool and cheese. The city manufactures furniture, yarn and rubber goods. Ravenna was settled in 1852 and incorporated as a city in 1912. Pop. 1920, 7,219; 1930, 8,019.

RAVENNA, BATTLE OF, 1512, an engagement of the Italian Wars by the French troops under Gaston de Foix, aided by 5,000 German mercenaries, against the Holy League formed by the Pope, Spain and Venice to drive out the invader. The French were besieging the city of Ravenna, against Spanish and Papal forces, led by Pedro Navarro, making an attempt to relieve the garrison. Unsuccessful at first in driving the Spaniards from their strong position the French outflanked their right and defeated them; but their leader, Gaston de Foix, was killed.

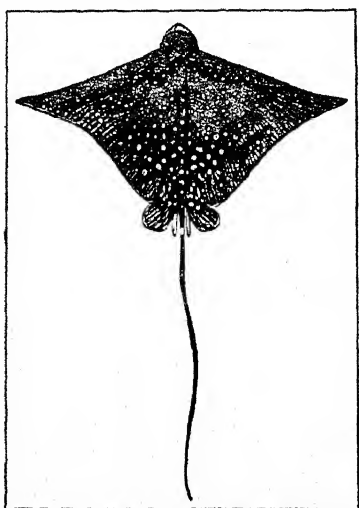
RAVENNA, EXARCHATE OF. When Justinian reconquered Italy he set up a local representative bearing the title of Exarch, with Ravenna, instead of Rome, as the capital. In 568 the Lombards entered Italy and soon overran much of the peninsula. The emperor, Maurice, 582-602, thereupon organized the Exarchate of Ravenna. Theoretically it included all Byzantine possessions in Italy; in fact it was limited to the territory extending southward from the mouth of the Po past Rimini and inland to the Apennines. Ravenna became the center of Byzantine influence in Italy. Several examples of Byzantine architecture still exist there. The Exarchate was weak; the emperor was too occupied with difficulties in the east to furnish adequate support to his western representative. The papacy emerged as a rival Italian power. The Lombards were a constant menace during the life of the Exarchate, which was finally extinguished in 751 when Ravenna was captured by the Lombard king, Aistulf.

RAVENSARA NUT, the fruit of a small tree (*Ravensara aromatica*) of the laurel family native to Madagascar. The somewhat acrid kernels, known as clove nutmeg, are used as a spice as are also the aromatic leaves.

RAVINIA PARK, a park and music center 21 mi. north of Chicago, fronting on Lake Michigan. For a ten-week season, during the summer months, operas and concerts are given at Ravinia Park by some of the finest companies at moderate cost. The beautiful grounds are available for everyone's use.

RAWLINS, a city in southern Wyoming, the county seat of Carbon Co. It is situated 309 mi. northwest of Denver, Colo., and is served by the Union Pacific Railroad and by bus lines. There is a municipal airport. Rawlins is a trade center and shipping point for a grain-growing and sheep-raising region. Coal, oil and gas are found in the vicinity. Rawlins, founded in 1867, is surrounded by many scenically interesting places. Pop. 1920, 3,969; 1930, 4,868.

RAY, a group (*Batoidei*) of moderate or large-sized fishes allied to the sharks, found widely in salt waters. They have broad, much flattened bodies, enormously developed pectoral fins which extend forward along the sides of the head, inferior gills, and relatively small tails, which in some forms become long and whiplike. The eyes are on the upper



COURTESY AMER. MUS. OF NATL. HISTORY

WHIP RAY

side of the body and the mouth, which is provided with flattened, blunt teeth, is on the under side. On the top of the head are two large spiracles, through which the animal may breathe while lying on the bottom. Rays are generally sluggish in habit, living chiefly on the sea bottom and feeding largely on shellfishes, crabs and other invertebrate animals. Although the skates lay large eggs contained in leathery cases (capsules), most other rays bring forth their young alive. In North America rays are of little economic value, but in the Old World various species are utilized for food.

Rays are classified in two groups according to the shape of their tails. The first group, the thick-tailed rays, includes the sharklike sawfishes (*Pristididae*), the guitar-fishes (*Rhinobatidae*), and the exceedingly flat skates (*Rajidae*) and torpedoes (*Torpedinidae*). The second group, the whip-tailed rays, includes the sting rays (*Dasyatidae*), the eagle rays (*Aetobatidae*), and the sea devils (*Mobulidae*). See also SKATE; STING RAY; TORPEDO RAY.

RAY, in general, a single line along which radiant energy is directed, as in the case of an X-ray, a ray of light, or heat rays. In geometry, it is one of a system of diverging infinite lines passing through a point. See PENCIL OF RAYS.

RAYLEIGH, JOHN WILLIAM STRUTT, 3rd Baron (1842-1919), English physicist, was born in Essex, Nov. 2, 1842. He was Cavendish professor of physics at Cambridge from 1879 to 1884, and in 1887 succeeded John Tyndall as professor of natural philosophy at the Royal Institution. He was elected to the Royal Society in 1873, received the Order of Merit in 1902, the Nobel Prize in physics two years later, and became chancellor of Cambridge University in 1908. The results of his varied researches included an explanation of the blue color of the sky by the scattering and polarization of light by small particles, the formula covering the radiation from black bodies in the region of long wave-lengths, a wave theory explaining earthquake phenomena, and his classical researches, conducted jointly with Sir William Ramsay, on the density of atmospheric nitrogen which, in 1894, led to their discovery of argon. He was interested in aviation, being a president of the Asquith aeronautics commission of 1909. He died at Witham, Essex, June 30, 1919.

RAYMOND, HOWARD MONROE (1872-), American educator, was born at Grasslake, Mich., Oct. 25, 1872. He graduated in 1893 at the University of Michigan, where in 1894 he took postgraduate work in physics and electricity. The next year Raymond began his long term of service with the Armour Institute of Technology, serving as instructor in physics until 1903 and as dean of engineering, 1903-22, when he became president.

RAYNAUD'S DISEASE, a condition first described by a French physician, Maurice Raynaud, in 1864; the chief manifestations of which are changes in color of the skin of the fingers and toes and very rarely of the nose, cheeks and ears. These changes, which occur much more frequently in women than in men, are due to exposure to cold, to nervous strain, or without demonstrable cause.

Ordinarily the skin first becomes white; then blue, next red, and finally the color becomes normal. When the affected parts are white they are numb and feel "dead"; extreme coldness is associated with blueness, and tingling occurs when redness appears. Sometimes there is absence of the phase of redness; also, whiteness or blueness may be the only change in color. There is no change in structure of the arteries of the extremities involved, as occurs in diseases of

the arteries known as thrombo-angiitis obliterans and arteriosclerosis with occlusion which may be associated with similar changes in color. Certain diseases of the nervous system, associated with changes in the color of the skin, must be excluded from the diagnosis.

Usually the changes in color occur for years, and gradually the return to normal between attacks becomes less nearly complete, until blueness is present more or less permanently. In many cases there is thickening and loss of elasticity of the skin of the fingers, toes, face and neck, until the features lose a large measure of their capacity for expression, and movement of the toes and fingers is limited. Because of this change in the skin, the hands frequently cannot be closed. In an advanced stage, brownish areas may occur on the tips of the fingers; these fall away and are replaced by small sunken scars. This process may often recur. Death or loss of a finger or toe rarely, if ever, occurs. Pain is usually a minor manifestation.

In the mild and early phases of the disease, residence in a warm climate and freedom from worry or other nervous strain may give relief. Operation on the sympathetic nerves apparently offers excellent results; complete cure is obtained by this operation in the usual case and the condition is distinctly benefited in more advanced cases. The sympathetic nerves control the sweat glands and the size of the small blood vessels of the skin, but they do not affect motion or feeling. Removal of the proper segment of these nerves has not been followed by ill effects, although, on the parts deprived of this type of nerve supply, perspiration does not occur. *See also* NEUROSURGERY: Sympathetic Nerves. E. V. A.

RAYON. *See* VISCOSE SILK; YARNS, SYNTHETIC; CELLULOSE.

RAZORS are keen edged instruments for removing the beard or hair as closely as possible to the skin. They were fabricated at one time from copper alloys but now are made of steel. Razors are divided into two classes: first, straight or unguarded razors and second, safety razors.

The unguarded razor consists of a bare blade which folds into a suitable handle or sheath. This type offers no protection against injury during shaving and has been almost wholly superseded by the safety razor.

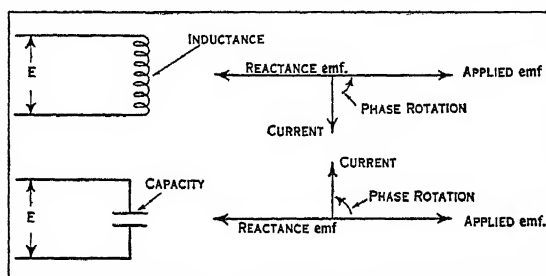
The modern type of safety razor consists of a thin blade and a handle so designed as to prevent injury during shaving. Blades may be single or double edged but the latter are more generally used. They are supplied with keen edges ready for use. Compared with the straight razor, they are inexpensive and are discarded after reasonable use. H. E. K. R.

RE. *See* RA.

REA, SAMUEL (1855-1929), American railroad official, was born at Hollidaysburg, Pa., Sept. 21, 1855. At first a surveyor's chainman with the Pennsylvania Railroad, after he had learned the rudiments of railroad engineering, he became assistant engineer of the Pittsburgh & Lake Erie Railroad, returning to the Pennsylvania in 1879. From 1879-89 he was

assistant engineer of the Pennsylvania Railroad, and 1889-91 was chief engineer on the construction of the belt-line tunnel under Baltimore, Md., for the Baltimore & Ohio Railroad. In 1892 he was made assistant to the president of the Pennsylvania Railroad, of which road he became president in 1913, serving until 1925, when he retired under the pension regulations of that company. He had charge of the construction of the Pennsylvania station in New York City, the railroad's tunnels under the Hudson and East rivers, and Hells Gate Bridge. In 1917 he was appointed to the national defense committee of the Railroads War Board. He died at Philadelphia, March 24, 1929.

REACTANCE, that property of an alternating-current circuit which produces a drop in the electromotive force that is 90° out of phase with the current. Reactance may be either inductive or capacitive (*see* INDUCTANCE; CAPACITANCE), but, in either case, it is an electromotive force that opposes the applied e.m.f.



REACTANCE CIRCUITS

Showing simple inductive and capacitive circuits with the vector diagram of each E is the applied electromotive force

In inductive reactance this opposing e.m.f. is 90° behind the current in phase, while in capacitive reactance it is 90° ahead of it. Reactance is measured in ohms and is expressed by the equations

$$x_i = 2\pi fL \text{ and } x_o = \frac{-1}{2\pi fC}$$

where x_i is inductive reactance, x_o capacitive reactance, f frequency, L inductance and C capacitance.

REACTION, CHEMICAL. The criterion of a chemical reaction is that one or more substances shall disappear from the system, at least in part, and that another substance, or other substances, shall appear. In some instances it is difficult to distinguish sharply upon a logical theoretical basis between physical changes and chemical reactions. In general, however, such alterations as changes in state, solution, and allotropic transitions (*see* ALLOTROPY) are regarded as physical rather than chemical. Chemical reactions may be classified from various points of view. Those which are accompanied by evolution of heat are termed EXOTHERMIC REACTIONS; those which result in absorption of heat are called ENDOTHERMIC REACTIONS. Reactions which result in changes of valence among the reactants are called oxidation-reduction reactions. The characteristic reaction between acids and bases is given the specific name, NEUTRALIZATION. Reactions of the type $A + B \rightarrow AB$, are called addition reac-

tions. Those which consist in simple ionic interchanges (*see* IONIC THEORY) without alterations in valence are known as double displacements or METATHESSES. Reactions are said to be mono-, bi-, or trimolecular, accordingly as one, two or three molecules take part. *See also* CHEMICAL EQUATIONS; CHEMICAL EQUILIBRIUM.

O. R.

REACTION TIME, that time required for a stimulus to register a response. It may be illustrated by the iris reflex. When a noxious stimulus approaches the eye, the stimulus causes the iris reflex to close the lid before the stimulus reaches the eye. The reaction time is the time it takes for the lid to close after there is awareness of the approaching stimulus. This varies with the different senses and also in different persons, and even in the same individual at different times. It may be slowed by means of fatigue and either quickened or slowed by the use of drugs.

The reaction time measures the rapidity with which the nerve current travels. It includes the making of a complete circuit from the point of sensory stimulation to the adjusting centers through the motor pathways. This is known as the sensorimotor circuit. Reaction time is more complex in such phenomena as recognition and association.

READ, THOMAS BUCHANAN (1822-72), American poet and artist, was born in 1822 in Chester Co., Pa. He lived much of the time abroad, chiefly in Rome, where he took up painting. His best known poem is *Sheridan's Ride*. Among his other works are *Poems, Lays and Ballads*, and *The House by the Sea*. Read died in 1872 in New York City.

READE, CHARLES (1814-84), English novelist and playwright, was born in Ipsden, Oxfordshire, June 8, 1814, and was educated at Oxford. His first comedy was *The Ladies' Battle*, 1861, and his greatest dramatic success was *Masks and Faces*, 1852, written with Tom Taylor, as was also *The King's Rival*. Other plays include *The Lyons Mail* and *Nance Oldfield*. His last dramatic venture was the celebrated *Drink*, adapted from Zola's *L'Assommoir*, and produced in 1879. Reade wrote many novels of which the fine historical story, *THE CLOISTER AND THE HEARTH*, 1861, is the best known. Among his other novels, many of which were directed against contemporary social evils, are *Love Me Little*, *Love Me Long*, 1859, *White Lies*, 1860, *Hard Cash*, 1863, *Griffith Gaunt*, 1866, *A Terrible Temptation*, 1871, *A Simpleton*, 1873, and *A Woman-Hater*, 1877. Reade documented his works with thousands of factual details; he was a vigorous stylist and a master of plot-construction. He died in London, Apr. 11, 1884.

READING, RUFUS DANIEL ISAACS, 1st Marquess of (1860-), British statesman, was born in London, Oct. 10, 1860. Educated in London, he studied law and was called to the bar in 1887. He entered parliament for Reading in 1904, was Attorney-General in 1910, a member of the cabinet in 1912,

and made Lord Chief Justice in 1913. During the World War he headed the Anglo-French Commission negotiating for an American loan. At the close of the war he was Viceroy of India, returning to England in 1926. He was created a baron 1913, a viscount 1916, an earl 1917, and a marquess 1926.

READING, county town and a county borough of Berkshire, England, lying 36 mi. southwest of London in the Thames valley, with the Thames, and the Kennet and Avon Canal affording waterways. Originally Roman, it was a Danish and Saxon battleground, later being granted to the great abbey founded in 1121 by Henry I. Portions of the ancient town walls survive, and the churches include the restored 14th century Grayfriars' which, from the Dissolution until 1864 served as town hall, workhouse and jail. Oscar Wilde wrote *De Profundis* and *The Ballad of Reading Gaol* while imprisoned in the town. To-day Reading has a University College, 1892, affiliated until 1926 with Oxford, and many public buildings. An important railway center it also has fabric manufactures, potteries, bakeries, riverside boatbuilding works and a large agricultural trade. Pop. 1921, 92,278; 1931, 97,153.

READING, a town and village in Middlesex Co., northeastern Massachusetts. The village is situated about 12 mi. northwest of Boston and is served by the Boston and Maine Railroad. The town has a variety of manufactures, including shoes, ear phones for the deaf, organ pipes, radio instruments and rubber products. There are dairy, fruit and poultry farms. Once a part of Lynn, Reading was separated from that city and incorporated in 1644. Pop. 1920, 7,439; 1930, 9,767.

READING, a city in Hamilton Co., southwestern Ohio, situated 15 mi. north of Cincinnati. It is served by the Pennsylvania Railroad. The city has glass, match and firework factories. Reading was settled in 1797; incorporated in 1851. Pop. 1920, 4,540; 1930, 5,723.

READING, a city in eastern Pennsylvania, the county seat of Berks Co. It is situated on the Schuylkill River, 58 mi. north of Philadelphia; it is served by bus and truck lines and two railroads. Two airports are in the vicinity. The city is within a short distance of extensive coal fields, and is a shipping market for the agricultural products of the vicinity. It ranks fifth among the cities of the state in industrial importance and has more than 700 factories. The principal products are manufacturing machinery, alloy steel, silk underwear, hosiery, iron pipe, hats, cigars, candy and optical goods. In 1929 the factory output was worth about \$120,000,000; the wholesale trade proper amounted to \$36,134,278, and the retail, to \$73,558,198. Reading is the seat of Albright College and of extension branches of the University of Pennsylvania, Wharton School and Pennsylvania State College Engineering School. The city has a symphony orchestra. The sons of William Penn, Thomas and Richard, founded Reading in 1748; it became a city in 1847. Pop. 1920, 107,784; 1930, 111,171.

READJUSTERS, members of a political faction in Virginia, 1878-85, which favored the downward revision of the public debt. Its leaders were Gen. William Mahone and H. H. Riddleberger. Gaining a majority in the legislature, the Readjusters announced that no part of the interest upon the debt incurred during the Civil War and the Reconstruction Era should be paid, and passed bills to that end which the governor vetoed. With Republican assistance, the Readjusters secured complete control of state politics in 1881, and among other measures designed to harass creditors of the state reduced the principal of the debt by about 35 per cent, and assigned to its payment only that portion of the state's revenues for which no other use could be found. The United States Supreme Court declared much of this legislation unconstitutional, as an impairment of the obligation to contract. Ultimately a compromise between the bondholders and the state was effected.

REAGENT, in chemistry, a substance used to produce a change in another substance for the purpose of determining its component parts, its percentage composition, or, in the case of a solution, to precipitate a solid substance (*see* PRECIPITATION). The reagent to be used necessarily varies according to the composition of the substance with which it is to react.

REALGAR, a bright red to orange yellow mineral, varying from transparent to translucent. A sulphide of arsenic, it contains more arsenic than its near relative, ORPIMENT. Both crystallize in the MONOCLINIC SYSTEM. It occurs in veins with silver and lead ores, as a sublimation product in volcanic regions, and in some hot spring deposits. It is found also in the stacks of furnaces roasting arsenic ores.

Realgar occurs in Hungary, Switzerland, Utah, Yellowstone Park, and Washington State. It was formerly used in fireworks for intense white light, but now the artificial mineral is used. *See also* ARSENOPYRITE; VULCANISM; ORE DEPOSITS.

REALGYMNASIUM, a secondary school in Germany offering a nine-year course in Latin, mathematics, science, and modern languages. These semi-classical schools were evolved as a concession to the opponents of strictly scientific education. Rapid commercial and scientific development led to their recognition in 1859, and since 1900 the realgymnasium has enjoyed equal privileges of graduation with the classical gymnasium.

REALISM, a theory holding to the independent being of universals; the position that things are in no way dependent for their existence on their being known. The first meaning is metaphysical, the second epistemological.

Realism in its first meaning goes back to PLATO. A Platonic Idea is essentially a realistic universal. This is one of the paradoxes in the history of thought: Plato, the original idealist, was the founder of what later developed into realism. It was in the controversy over universals that realism in this sense played its dominant rôle in the Middle Ages. Here it was the opposite of nominalism.

In its epistemological meaning realism holds to the theory of independence, i.e., that knowledge is not essential to being. Things exist apart from their being known. Metaphysics is not dependent upon epistemology. Here realism is the opposite of subjectivism. This theory of independence is the first plank in the platform of the neorealists.

REALISM, in literature, a tendency to transcribe life exactly as the writer sees it, with a scrupulous fidelity to its everyday phases and details regardless of their ugliness or beauty, and a deliberate refusal to idealize or romanticize the actual data. The realistic movement became pronounced in the 19th century, and represented both a revolt from ROMANTICISM and a conscious attempt to align literature with the scientific attitudes and methods then dominant. It was most powerfully realized in France, in the works of such writers as Balzac (*La Comédie Humaine*), Stendhal (*Le Rouge et le Noir*), Flaubert (*Madame Bovary*), Guy de Maupassant, and Zola (*Nana*, *Le Débâcle*). Also important were the Russian realists, notably Dostoyevski, Tolstoy, Chekhov, and Gorki; in England, Thomas Hardy and George Moore; and in recent times, Galsworthy, Arnold Bennett, Somerset Maugham and D. H. Lawrence. Among the American writers who have striven for realism are Bret Harte, Mark Twain, William Dean Howells, Stephen Crane, Ambrose Bierce and Frank Norris; and, more recently, Theodore Dreiser, Sinclair Lewis, John Dos Passos and Ernest Hemingway. *See also* FRENCH LITERATURE; RUSSIAN LITERATURE; ENGLISH LITERATURE; AMERICAN LITERATURE; separate articles on the authors above.

BIBLIOGRAPHY.—F. Brunetière, *Le roman naturaliste*, 1893; G. Brandes, *Main Currents in Nineteenth Century Literature*, 1906, 1923; W. L. Myers, *The Later Realism*, 1927; E. A. Baker, *A History of the English Novel*, 1929.

REALISM, in painting, a term applied to the art of Gustave Courbet (1819-77) and his followers. Courbet was the revolutionary leader against the combined formalism of CLASSICISM and the idealism of ROMANTICISM which dominated French painting in the middle of the 19th century. Passionately attached to his native countryside of Franche-Comté and its peasants, Courbet was interested in direct observation of nature and was a determined enemy of artificiality. He was strongly attracted by the realism inherent in Dutch and Spanish art, and was most profoundly influenced by Velasquez. He took his subjects from the everyday life about him, painting only what appeared to his eye in physical aspect. His handling suggested substance and volume, strengthened by the use of heavy dark shadows to give the effect of power and force. His claims that his pictures were good because they were true and that the value lay in the painting and not at all in the subject have ever since been the rallying cry of the Realistic School. EDOUARD MANET, influenced by Courbet's realism and unidealization of subject, brought to the forefront what Courbet had failed to see, the air or atmosphere, suffusing it with light and color. He banished the somber shadows and

made the hard surface of Courbet's realism reflect a luminous and vibrant light; he lost, however, Courbet's powerful handling and massive sense of form. *See also IMPRESSIONISM.*

REAL PROPERTY, land and things treated as land; and "land" means the *space* occupied within a man's "close"; which in old dogma extends to the earth's center and the sky, though aviation is rapidly altering the latter idea.

Two fundamental concepts underlie the law of realty: possession and estate. The first is the basis and content of title. It is only very modern law that a person can acquire title by **DEED** from one whose land is in possession of another claiming title thereto. Of rights to use the land of another the most important are **EASEMENTS**.

As respects estates, under feudal tenure all land was held of a lord for a particular time, indicating the "estate"; and a landholder to-day has only an estate. Fees are estates of inheritance—a fee-simple if heritable simply by a man's heirs, lineal or collateral; a fee-tail if only by lineal descendants—but fee-tails are rare. Freeholds include fees and estates for life. Under the old law, leases for years certain (even for 999 years at a peppercorn rent) were not realty, wherefore they are still personalty. But estates at will are realty. In default of heirs, a fee-simple rather by virtue of **EMINENT DOMAIN** than of feudal lordship, escheats to the state.

Inheritance at **COMMON LAW** was by one heir through exclusion of females and preference of the first-born male; but **PRIMOGENITURE** has, with few exceptions, not existed in this country since colonial times, nor the exclusion of females. At common law an intestate's realty descended immediately to the heir; personalty went to the administrator, and the residue after settlement of the estate to the "next of kin." In most of our states this is still law, who the heirs or next of kin are depending upon state statutes. In normal cases the heirs and next of kin are identical. The widow's dower and widower's curtesy remain in most of our states, some substituting protection under altered rules of inheritance.

Conveyances of land operate either under the Statute of Uses of 1536 or by force of modern statutes. Land has always in this country been abundant, cheap, and the subject of active commerce; conveyances thereof are relatively simple. This has lessened the evils of the law's antiquated technicalities and will facilitate their eradication.

The land law is further complicated by consisting of a "legal" and an "equitable" portion. **MORTGAGES** and **TRUSTS** are creatures of equity, with peculiar rules overriding conflicting principles of non-equity law. Publicity of conveyancing, secured by registration of deeds, is of tremendous importance in giving knowledge of prior claims, legal or equitable, thus affecting priority among them.

In general our land-law is still full of medieval technicalities. Save in a few states there has been only tinkering with individual doctrines. F. S. P.

REALSCHULE, a secondary school of Germany, offering a six-year course in modern subjects. Graduates are given the choice of one year's military service or entrance into certain branches of public activity. These schools were originally founded for those who "possessed ability, but desired neither knowledge of traditional subjects nor the learned professions."

REALTOR, a business man who buys, sells and deals in real estate. Before everything else, a realtor should be a good **SALESMAN**. He should be thoroughly grounded in real estate law (*see REAL PROPERTY*), and should understand the principles of property appraisal and taxation. A knowledge of bonds, mortgages and real estate loans is essential, and an instinctive sense of why people prefer one location to another will prove highly valuable. Though not necessary, a college education so widens the realtor's outlook that it will prove a great asset to him in his private business and in his civic cooperation with the larger town and regional planning which is rapidly becoming a matter of large importance in human welfare. J. P. D.

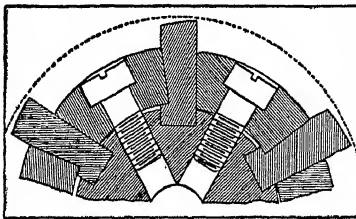
REAL WAGES, goods and services actually enjoyed by the worker, or the purchasing power of nominal or money wages measured by a constant standard. A slight adaptation of material gathered by Thorold Rogers shows real wages in England from the period 1261 to 1702. In 1261-1350 to obtain a given grain diet the laborer had to work 33 weeks, in 1351-1400, 24 weeks; in 1401-1540, 27 weeks; in 1541-1582, 42 weeks; in 1583-1642, 59 weeks; in 1643-1702, 55 weeks. A meat diet would have called for four to nine weeks more of work. According to this the laborer could satisfy his standard of living with less labor in the second half of the 14th century than at any subsequent time. In the first half of the 18th century real wages rose above those in the 17th century, but, due to the advance in prices in the eighth and ninth decades of the 18th century, the purchasing power of wages fell 20%, so that by the beginning of the 19th century real wages were back to the low level of 1583-1642. Between 1810 and 1852 real wages in the United Kingdom rose slowly. Professor Bowley calculated that real wages in England, taking 1860 as 100, rose to 192 in 1891, the sharpest increase being from 139 in 1880 to 180 in 1886. Bowley has also calculated real wages in the United Kingdom, 1913 being taken as 100, as standing at 54 in 1850-54, rising considerably to 1874, standing then at 67, nearly stationary till 1879, 71, rising till 1897, 103, the high point, falling somewhat till the depression of 1920-21, again 103, and thereafter falling to 96 at the end of 1924. The last figure is partly conjectural; Bowley considered it doubtful whether real wages had risen or fallen between 1913 and 1924. These calculations did not allow for unemployment overtime, or increase in productivity on piece rates after 1913.

In the United States, a compilation from the Senate (Aldrich) report of 1893 shows real wages (1860 equals 100), rising from 84 in 1845 until 1860, falling

to 69 in 1865, rising to 117 by 1870, and continuing the ascent to 183 in 1890. Professor Paul H. Douglas, after elaborate studies, has concluded that—considering the 5% decrease in the number of dependents per gainfully employed worker, the increase in free income furnished by government, philanthropy and employers, and the lowered rate of unemployment—the workers of the United States enjoyed a real income in 1926 averaging 55% higher than that of the nineties. Real wages in urban work did not increase as rapidly between 1899 and 1925 as did physical productivity, but did increase as rapidly as the increase in value productivity. The main cause of the increase in real wages was the marked increase in the productivity of the workers. B. M.

BIBLIOGRAPHY.—A. L. Bowley, *Prices and Wages in the United Kingdom 1914-20*, P. F. Brissenden, *The Earnings of Factory Workers*; P. H. Douglas and F. T. Jennison, *Movement of Money and Real Earnings in the U.S. 1926-28*.

REAMERS, edged tools for enlarging holes previously made with a drill or a boring bar. They are used to produce uniformity in diameter and a smooth surface in the hole. There are many types of reamers, some being solid and others having adjustable



COURTESY PRATT & WHITNEY CO

CROSS SECTION OF ADJUSTABLE BLADE REAMER

To set this reamer, the shoes are loosened and the nuts run back. The blades can then be pushed back and the shoes tightened.

blades so that they may be enlarged when the cutting edges wear and need re-grinding. Reamers are made for both straight and tapered holes and with straight teeth and teeth that are curved or helical. The helical tooth gives a diagonal cut that leaves a smoother surface.

REAR ADMIRAL, an officer of the Navy ranking next to Vice Admiral. Since the grades of ADMIRAL and Vice Admiral on the Active List have become extinct, the grade of Rear Admiral is the highest rank in the line Navy. The grade of Commodore also has been abolished, with the exception of those officers on the Retired List in that rank.

All Rear Admirals rank with Major Generals in the Army. For the purpose of pay, however, the senior half of the active list of Rear Admirals receives the same pay as do Major Generals. The lower half receives the same pay as Brigadier Generals. Rear Admirals usually command a fleet or a division of a fleet.

REASON, in philosophy, a principle of nature; a faculty of the mind; a logical function. The first

conception is metaphysical, the second psychological and the third logical.

Reason in the metaphysical sense applies to the nature of the universe. To the Stoics reason represented the soul of the universe. To be in touch with nature was to live rationally. GEORG WILHELM FRIEDRICH HEGEL regarded the universe as essentially rational in character and Reason as the essence of the Absolute.

The conception of reason as a faculty of the mind is no longer in good standing. The contrary was true, however, in the days of faculty psychology, and this conception played a prominent part in the ethical systems of both PLATO and ARISTOTLE. For Plato the good life consisted in the subordination of the sensuous pleasures to reason. Aristotle held that it was the function of reason to arrive at the Golden Mean of conduct.

Kant used reason in an *a priori* sense as an active function which transcended experience. From the standpoint of knowledge it supplied three regulative ideas, those of self, God and world. Since these ideas of Reason were too big for the understanding, knowledge was shipwrecked at this point. From the standpoint of ethics, it was the dictates of reason that should be obeyed. Here reason was an intuitive faculty deriving its authority from its universality.

Reason as a logical function is a more modern way of describing what was formerly explained by reason as a faculty.

RÉAUMUR TEMPERATURE SCALE. On the Réaumur scale the ice-point is marked 0° and the boiling-point 80°. Thus, the *fundamental interval* (see THERMOMETRY) is divided into 80 degrees. This temperature scale is used chiefly in parts of central Europe and Russia. Temperatures on the Réaumur scale, *R*, can be reduced to the corresponding Fahrenheit, *F*, and centigrade, *C*, temperatures by the formulas,

$$F = 32 + \frac{9}{4} R \text{ and } C = \frac{5}{4} R. \text{ Thus, } 16^\circ R. = 68^\circ F. = 20^\circ C.$$

REBEKAH, in Biblical narrative the wife of Isaac, who married her although she was an Aramaean. Isaac was then 40 years old and the Bible story details their unusual courtship, and finally the birth of their children Esau and Jacob after Isaac and Rebekah had been married for 20 years.

REBELLION LOSSES BILL OF 1849, a bitterly controversial issue in Canadian history. During the REBELLION OF 1837 many loyal citizens had suffered losses or damages. In 1845 tavern-licenses and other revenues amounting to £40,000 were appropriated for payment of loyalist claims in Upper Canada. Prospect of a larger fund for similar purposes in Lower Canada aroused fears of the Conservatives that the appropriation would be diverted to paying the losses of rebels. The measure introduced in 1849 was in fact designed with sufficient liberality to please the French-Canadian members of the government. Sponsored by Louis Hippolyte Fontaine, the French-Canadian leader of the ministry, it created a new

commission to administer £100,000, to be raised by a special bond issue, for compensation of all "just losses" incurred during the Rebellion. Those who had actually been convicted of treason, or deported, or confined in jail, were excluded from compensation. The Lafontaine-Baldwin coalition was denounced by loyalists as the "Rebel Ministry"; riot was narrowly averted in Parliament; but against violent opposition the bill passed. Lord Elgin was petitioned to dissolve Parliament, or at least to reserve the bill for the pleasure of the Crown, but the governor-general refused to shift responsibility in a matter of purely Canadian concern to imperial authorities. As Lord Elgin left Montreal after having assented to the measure, he was assaulted by a mob. Three days' rioting ensued, in the course of which Parliament House was wrecked and the homes of members who had voted for the bill were razed. Extremists petitioned the intervention of the British Parliament, but in the House of Commons Lord Elgin's position was sustained. Following the disorder in Montreal the capital was removed to Toronto. Lord Elgin's attitude did much to draw the French-Canadian element into closer bond with the Union and Parliament's attitude put an end to the practice of appealing to Great Britain by petition.

REBELLION OF 1837, in Upper and Lower Canada, the protest of an aggressive minority against misgovernment and arbitrary administration. Animosity which had long smouldered against the **FAMILY COMPACT** in Upper Canada, and the counter-part oligarchy, the **Château Clique**, in Lower Canada, threatened violence in the late spring of 1837, when news arrived of resolutions presented in the House of Commons by Lord John Russell of the British Colonial Office, flatly rejecting the demand for responsible government and strengthening the rule of the reactionaries. **LOUIS JOSEPH PAPINEAU** and other Radical leaders in Lower Canada organized popular demonstrations. In Upper Canada **WILLIAM L. MACKENZIE**, editor of the inflammatory *Constitution*, and his fellow extremists made plans for a cooperative movement with the reformers of the other province. Radicals armed and drilled, and in emulation of the American Revolutionists boycotted British goods, wore homespun, and donned "liberty caps." In Lower Canada the expression of French national spirit complicated the constitutional issues; in Upper Canada the overbearing attitude of the lieutenant governor, Sir Francis Bond Head, was an additional aggravation.

The arrest of Papineau and 26 followers, Nov. 16, invited the beginning of hostilities; a detachment of British troops was routed and the prisoners freed. A government force attacked and dispersed a rebel army at St. Denis, another at St. Charles. Thereafter the rebel army about Montreal disintegrated rapidly; after several minor skirmishes, the surrender of a rebel force at St. Eustache capped the failure of the movement in Lower Canada. The masses had remained passively neutral; the attitude of the Church dissuaded many French-Canadians from rebelling.

In Upper Canada Mackenzie, taking advantage of the removal of troops from Toronto to serve in the Montreal district, planned to take the capital city, seize the governor, the public buildings and the military magazines, and demand the immediate creation of a responsible government. He could muster only 800 troops of an expected 5,000; the force dispersed in panic under artillery fire, and Mackenzie took refuge across the border. At Buffalo he was enthusiastically received; the New York officials ignored violations of the neutrality laws. On Navy Island, two miles above Niagara Falls on the Canadian side, Mackenzie proclaimed the establishment of a provisional government of Canada, Dec. 13. The rebels held the island for several weeks without interference. The **CAROLINE INCIDENT** advanced the popularity of the Rebellion among Americans along the border. On Jan. 13, 1838, Mackenzie evacuated Navy Island, was arrested by United States authorities, and ultimately served 11 months in prison for violating the neutrality laws of the United States. The Rebellion was protracted through 1838 by occasional forays across the border of American sympathizers. (See **HUNTERS' LODGES**.) Although the frustrated work of a small minority, the Rebellion was of great importance in directing the attention of Great Britain to problems of colonial government. E. D. B.

REBUS, a form of riddle portraying the meaning of a sentence, or a single word, by the use of picture writing, or a combination of pictures and letters, or words. The rebus is thought to have originated in Picardy. Rebus may also refer to an arrangement of letters or syllables in a position, to be taken into account, when guessing the meaning of the word.

For instance, ^S**FLO** is a rebus way of representing flo (under) s, flounders. In heraldry, a coat of arms may suggest the meaning of a name in picture form. This is called rebus, or allusive arms.

REBUS SIC STANTIBUS. See **ABROGATION**.

RECALL, a device most common in the states of the United States, although used in other countries, whereby an official may be removed from office by the voters before his term has expired. Under the recall, if a petition has been circulated and signed by a certain specified number of people who are dissatisfied with the official, the number of those who must sign varying according to the state ruling in the matter, the official must then go before the voters at a special general election to find out whether the majority wish to continue him in office or not. The recall is based on the principle and theory that elected officials are not free agents but only agents of the popular will. S. C. W.

BIBLIOGRAPHY.—Burd and Ryan, *The Recall of Public Officers*, 1930.

RÉCAMIER, JEANNE FRANÇOISE JULIE ADELAIDE (1777-1849), French social leader, was born at Lyons, Dec. 4, 1777. Née Bernard, at the age of 15 she married Jacques Récamier, a Parisian banker. Her great beauty and social talents made her the

recognized leader of Parisian society. In 1830 her husband died and she later lost the greater part of her fortune, but neither her unsullied reputation nor her social position were impaired. Her friendship with Chateaubriand began when she was about 42 years old and lasted till his death. Madame Récamier died in Paris, May 11, 1849.

RECEIVER. A person appointed by a court of equity for the preservation of property pending suit, or the conduct of a business or an enterprise pending litigation, as, for instance, to wind up partnership business in a suit for dissolution of a partnership, or the affairs of a corporation in process of dissolution, or to conduct a public utility pending reorganization.

RECEPTORS, receiving points for sensory stimuli; end organs, such as the eye or the ear. The receptors are at one end of the sensorimotor arc, the effectors at the other. All receptors are at the receiving end. It is through them that sensations are initiated, and they may be classified according to the location of the stimulus initiating the sensation. The three main divisions of receptors are exteroceptors, proprioceptors and interoceptors. Among the exteroceptors are such end organs as the eye, ear and skin. Muscles, joints and tendons constitute the proprioceptors, while the interoceptors are located in the digestive tract. Hunger may be cited as an illustration of interoceptive activity. The stimulus to the sensation is an internal one, arising in the digestive tract. The proprioceptors come into play from the sensations of muscular activity.

RECHABITES, the name of a Hebrew society or sect which seems to have been prominent in early prophetic days. They appear and disappear in Israel's history almost mysteriously. Assuming that the Jehonadab whom Jehu took up in his chariot, and thus joined with himself in his bloody work for the Lord (II Kings 10, 15 f.), was the Jonadab mentioned in Jeremiah 35, as the ancestor of the Rechabites, who prohibited to his descendants the drinking of wine, it may be inferred that in Elisha's days a sect or family, or perhaps order, existed, pledged not to drink wine, regarding it as the symbol of a corrupted civilization, and pledged not to engage in agriculture or in the building of homes. They were thus pledged to the primitive nomadic life. The pledge was made in the service to God. The life of the Rechabites was a protest against luxury, intemperance and idolatry, as well as against the Canaanitish civilization of the day. It was a reaction towards the primitive simplicity of Israel and a protest against contaminating elements from the Canaanitish cults which then found their way into the life of Israel.

See M. Battenwieser, *The Prophets of Israel*, 1914.

RECIFE or **PERNAMBUCO**, capital of the state of Pernambuco, on the Capibaribe and Beberibe rivers, near the farthest eastern point of Brazil. The port is protected by a coral reef parallel to the shore, where a breakwater three-fourths of a mile long and jetties have been constructed.

Canals divide the city into three sections, Recife

proper, a compact old town upon a peninsula; San Antonio, on an island between Recife and the mainland; and Boa Vista, on the mainland itself. All are connected with bridges. In general, the streets are narrow and the buildings tall. The climate is hot, the temperature ranging from 61° to 100° F. Tropical diseases have been almost stamped out through the efforts of the government and the Rockefeller Foundation. The city has great commercial importance, exporting cotton and sugar, also rum, hides and cereals. Its location in the heart of a productive agricultural district and its control of rail and sea routes have made Recife the collecting and distributing point for most of the region. Fourth among the cities of Brazil, it has important industries devoted to sugar refining, tobacco and cotton textiles. Other than Recife, northeastern Brazil has no great centers.

Recife, sometimes called Pernambuco, was founded by the Spaniards in the second half of the 16th century. The English captured it in 1595, the Dutch in 1630 and the Portuguese in 1654. Est. pop. 1930, 340,543.

RECIPROCITY, in general, a condition of mutuality and exchange, in which the parties enjoy the same rights under equal conditions. In regard to treaties, it means an agreement under which states allow citizens of other states to share in certain privileges of trade and commerce in return for the same rights for its own citizens. In European countries, privileges granted one nation under the FAVORED-NATION CLAUSE could be claimed by another state. In the United States a reciprocity agreement is deemed exclusively bilateral, and the concern only of the two countries, without reference to others, even though they may enjoy most-favored-nation treatment.

RECIPROCITY TREATY OF 1854, an agreement which attempted to settle the long-standing fisheries dispute between the United States and Canada, concluded June 5 and proclaimed Sept. 11. It was negotiated by W. L. Marcy, Secretary of State, for the United States, and the Earl of Elgin and Kincardine, Governor General of Canada. The treaty established considerable reciprocity in trade. Fishermen of the United States were given liberty to take sea fish off Canada, New Brunswick, Nova Scotia and Prince Edward's Island without being restricted to any distance from the shore, and permitted to land for drying nets and curing fish. British subjects were given similar privileges on the United States waters and coasts north of the 39th parallel. Citizens of the United States were given the right to navigate the St. Lawrence River without payment of tolls other than those ordinarily charged Canadians; Canadian ships were given freedom to navigate Lake Michigan. A lengthy enumeration of articles to be admitted from one country to the other without payment of duty included grain, animals and meats, fruits, fish, poultry and eggs, hides and furs, coal and timber. There was a general impression in the United States that Canada profited most by the treaty. When during the Civil War the Canadian Government allowed

its territory to be made a base of operations by the Confederacy, the United States gave notice of the termination of the agreement.

RECITATIVE, in music, free declamation with intermittent instrumental accompaniment, such as is found repeatedly in both OPERA and ORATORIO. It commonly introduces the ARIA. The earliest formal use of this device, known also as *musica parlante*, or spoken music, is to be discovered at the beginning of the 17th century in such operas as Jacopo Peri's *Euridice* and Claudio Monteverde's *Orfeo*.

RECKLINGHAUSEN, a city of western Germany in the Prussian province of Westphalia close to Herne. It is one of the oldest towns in the Ruhr region, having received its municipal charter as far back as 1236. A castle of the Duke of Arenberg is located here. In the midst of an industrial region Recklinghausen has coal mines, saw mills, and produces linen, powder, tin ware, brandy and beer. In 1905 it had 44,398 inhabitants. Pop. 1925, 84,609.

RECLUS, JEAN JACQUES ÉLISÉE (1830-1905), a French geographer, born in the Gironde at Ste. Foy la Grande, Mar. 15, 1830. He received his primary education in Rhenish Prussia and then attended the Montauban Protestant College and the University of Berlin. He left France in 1852 to travel in Great Britain, the United States and South America, returning to France in 1858, where he published a number of geographical works based on the information gathered in his travels. He was imprisoned, Apr. 5, 1871, for his aerostatic activities during the Siege of Paris and for membership in the revolting national guard. His sentence, transportation for life, was commuted in 1872, to banishment, upon petition of a group of scientists, whereupon he took up his residence in Clarens, Switzerland. He instituted the anti-marriage movement in 1882, and in 1883 he and Prince Kropotkin were sentenced by the tribune at Lyons as anarchist leaders of the International Workingmen's Association. Reclus's residence in Switzerland saved him from imprisonment. He accepted a position at the University of Brussels in 1892 as professor of geography. His outstanding work is *La Nouvelle Géographie universelle, la terre et les hommes*, 19 vols. 1875-94. He died near Bruges, Belgium, July 4, 1905.

RECOGNITION, the formal act of the executive by which a new state or government is admitted, so far as the recognizing power is concerned, to the family of nations. It is an acknowledgment of the equality, sovereignty and independence of the state, growing out of the demonstrated facts of international competence and stability. By it a state is invested with rights and charged with duties. One evidence of recognition is that of entering into treaty relations (*see TREATIES*) with another state. The reception and the accrediting of diplomatic representatives are modes of recognition which are executive in character.

RÉCOLLET MISSIONS. (Canadian.) Sailing with SAMUEL DE CHAMPLAIN on the *St. Étienne*, 1615, four Récollet Fathers came to New France where they

established the first mission in Canada. These four, Fathers Dennis Jamay, Jean d'Olbeau, Joseph Le Caron and Brother Pacificus du Plessis, were persuaded to this pioneer undertaking by the Sieur Houel, pious secretary to Louis XIII. A chapel was built at Quebec, and on June 24, 1615, the Day of the Feast of John the Baptist, the first mass in the province of Quebec was celebrated on the Rivière des Prairies by Fathers Jamay and Le Caron. Father le Caron, who went to the River Sault St. Louis, was the first missionary to make his residence among the savages (winter 1615-16). The Récollets, the only missionaries in Canada until 1625 (*see JESUIT MISSIONS*), encountered the hostility of the resident traders by attempting to have the Indians abandon trapping and hunting in favor of a sedentary, agricultural life. The trading company even forbade its French interpreters to teach the Récollets the rudiments of the Indian tongues. The missionaries learned from experience, however, that faith and virtue might be inculcated into the Indians without attempting to change their roving life. Although overshadowed by the Jesuits, the order continued its work. Among the later Récollets was Brother Gabriel Sagard, who wrote the *Histoire du Canada et Voyages des Pères Récollets en la Nouvelle-France*.

RECONNAISSANCE, an examination of a land or water area to gain information, made by scouts, detachments, aircraft or vessels. On land, aircraft may gain general positive information. But ground reconnaissance is necessary to procure detailed information or negative information, as, for instance, that the enemy is not in a certain locality.

RECONSTRUCTION ERA, in the southern states, the period from the close of the Civil War to the inauguration of President Hayes, Mar. 4, 1877, characterized by the restoration of the seceded states to their normal relations with the Federal Government, and by the adaptation of social economy to the new conditions involved in the abolition of slavery and the financial impoverishment of the South.

Early attempts at political reconstruction were initiated by President Lincoln, whose theory was that the seceding states continued to exist as members of the Union, although out of their proper relations with it because of unlawful subversion of the state governments. Under his moderate plan, as announced Dec. 8, 1863, including broad amnesty and the reestablishment of civil government by one-tenth of the number of voters in a state in the presidential election of 1860, Arkansas, Louisiana and Tennessee were "reconstructed;" but only the reestablished government of Tennessee, after the state had accepted the 14th Amendment, survived the hostility of Congress to the president's plan. President Johnson's attempts to carry out the policies of his predecessor were blocked and superseded by Congress, the Republican members of which professed to see in the stringent police laws of southern states an attempt to reenslave the Negroes. Congress enlarged the powers of the FREEDMEN'S BUREAU, after passing a

CIVIL RIGHTS BILL conferring full powers of citizenship upon the freedmen, and attempted to remove Johnson's opposition to its program by IMPEACHMENT. Failing in that prosecution, Congress passed the TENURE OF OFFICE ACT limiting the president's powers of removal, deprived the president of the chief command of the military and invested that power in Gen. Grant. The rejection of the proposed 14th Amendment by southern states precipitated, in Feb. 1867, a drastic enactment, dividing the 10 seceding states (Tennessee being excepted) into five military districts, and declaring the existing civil governments to be provisional only and subject to the authority of the United States. In March the IRON-CLAD OATH was made prerequisite to registration as a voter. Existing state officials were removed if they hampered the process of reconstruction; various matters of private law were regulated by military order, and military tribunals were created (for the prevention of discriminatory treatment of the freedmen) for various kinds of crime. In the winter of 1867-68 conventions, dominated by freedmen, CARPETBAGGERS, and SCALAWAGS, were in session in the 10 states to draft new constitutions. In seven states the constitutions were ratified by popular conventions; and, the 14th Amendment having been ratified by the newly constituted legislatures, these states were admitted into the full fellowship of the Union, June 22-25, 1868. To Mississippi, Texas and Virginia, as yet "unreconstructed," was added Georgia after its legislature arbitrarily expelled its Negro members. Congress imposed upon these states an additional requirement, the ratification of the 15th Amendment. In January-June, 1870, these states were admitted to the Union.

Political reconstruction seemed technically complete; social problems remained largely unsolved, and most of the native whites were yet excluded from the electorate. Local and state government was characterized by extravagance and ineptitude. The KUKLUX-KLAN and other societies of native whites further complicated the problem of restoring order in the South by political persecution and physical violence against the Negroes. Congress enacted a FORCE BILL and other measures to ensure the Negroes political and social equality, the most important provisions of which were later declared unconstitutional by the Supreme Court. Under this new legislation Federal troops returned to the South, charged with the duty of supervising elections. A minority in Congress protested that conditions in the South were not sufficient to warrant the stringent measures being taken; their protests led to the appointment, in 1871, of a Joint Committee on Reconstruction whose 13-volume report (House Report, 42nd Congress, 2nd Session, No. 22) is an essential mine of information. In 1872 a sweeping amnesty act removed political disabilities from all but a very few ex-Confederates; but Federal troops remained in the South until shortly after the inauguration of President Hayes, when the last of them were recalled from Columbia and New Orleans. Between 1870 and 1876 the native whites,

identified with the Democratic party, gained control of all southern states. (See SOLID SOUTH.) The ultimate effect was the retention by the Negro of civil rights; the loss of most political rights; his failure to gain social equality in any degree; and the substitution of systems of tenant farming in lieu of the plantation system.

E. D. B.

BIBLIOGRAPHY—W. L. Fleming, *Documentary History of Reconstruction*, 2 vols., 1906-07, assembles much source material. See also A. B. Hart, ed., *American History Told by Contemporaries*, vol. IV, 1901; W. A. Dunning, *Essays on the Civil War and Reconstruction*, 1904, bibliographical lists in W. A. Dunning, *Reconstruction Political and Economic*, 1907, and citations in J. F. Rhodes, *History of the United States from the Compromise of 1850*, vols. V-VII, C. G. Bowers, *The Tragic Era*, 1929, and particularly H. K. Beale, *The Critical Year*, 1930.

RECORDING ACTS. Statutes now universal in the United States and governing in some parts of England, providing for a public record of conveyances and other instruments affecting land, or sometimes also chattel property, for the purpose of affording notice to the world at large as to the title to property. It is usually provided that one who has taken a conveyance or other instrument for value without notice of the claims of others, and records without such notice, shall be preferred to those having unrecorded instruments under which otherwise they would have title.

RECREATION. Modern developments in recreation have taken many forms. Play activities in the home have diminished and have increased in playgrounds, scout troops, nursery schools, summer camps and in many institutions. Facilities are more economically provided for large rather than family groups; in fact in modern city apartments little opportunity offers itself for play provision. The growth of appreciation of psychological bases of play and also of professionalism in sports and play direction, has added emphasis to the tendency to provide recreation for groups of persons of the same age in large rather than in family or small groups.

The automobile has found its way into every home, at least into the statistical average home. Motion pictures are also a potent factor in changed recreation habits. Moving picture houses, it is said, have a seating capacity of one-tenth the population. The lessening of family and neighborhood controls, the need of serving masses of persons for dances, movies, billiards or miniature golf, has made possible and profitable a huge development of commercial recreation. Religious organizations have taken a hand in the provision of recreation in parish halls, church community centers, in Y.M.C.A.'s, Y.W.C.A.'s, Jewish centers and Knights of Columbus. In addition, character building agencies such as the Boy Scouts, said to number one-seventh of the eligible boys, have grown up.

The play of children from which the money returns of commercial exploitation would be small, and the informal out-of-door relaxation of adults that also offers little opportunity for commercial gain, were the foundation for a remarkable increase in municipal

provision of parks and organized recreation. In the United States and Canada in 1929 there were 7,284 outdoor playgrounds reported in 763 cities, and 2,255 indoor recreation centers in 248 cities. There were 1,709 athletic fields, 4,024 baseball diamonds, 409 bathing beaches, 299 golf courses, 81 stadiums, 115 summer camps, 1,010 swimming pools and 7,960 tennis courts.

These various developments in recreation, in addition to the huge system of professional athletics that attracts hundreds of thousands of spectators, serve special demands for the most part. Settlements, about 700, community centers and community houses numbering perhaps 7,000, and 800 or 1,000 communities built each as single real estate or cooperative ventures to house several hundred or even thousands of people, are attempting in greater or less measure to integrate the many social expressions and to bring about an integrity and relatedness among the inhabitants of a neighborhood, especially in their pleasurable pursuits.

One of the most significant movements is that of progressive or creative education which is making play a part of every activity or interest of the child, and is bringing about an integration of play and all other expressions in his growing years quite in contrast to the specialism and separateness of expression that is involved in most professional, social service, commercial and other recreation. LER. E. B.

RECREATION CAMPS, regions which have been set aside by municipalities to provide camping and other outdoor recreational facilities for their citizens. In the majority of such camps, a nominal fee is charged which is intended to defray operation costs; some are free. In 1930, 78 cities operated 134 camps. Attendance as represented by 60 cities (1930) totaled 121,074 persons. For the most part, the cities maintaining these camps are located in the far West and Middle West. The city of Los Angeles began the movement in 1911 and now maintains five recreation camps. There is wide variation in methods of management and facilities offered. The average season is 2.8 months. Camps have been established for children, usually having separate camps or camping periods for boys and girls, where they may enjoy organized and supervised swimming, hiking, horse-back riding, tennis, baseball, croquet and every form of outdoor recreation.

The camps are also maintained for adults and for entire families. In some camps the season is divided, a definite number of weeks being apportioned to children and to adults. Housekeeping cabins at the adult and family camps are an important feature. Camp Seeley, the great Los Angeles Municipal Mountain playground, is located $3\frac{1}{2}$ hrs. from the city in the pine-covered San Bernardino Mountains. It is a popular summer and winter camp, featuring tobogganing, sledding, skiing and other snow sports in the winter months. The Detroit Recreation Camp comprises over 300 acres of land surrounding Lake Recreation, 45 mi. from Detroit. This camp can accommodate 400 children a week and also admits adults.

RECRUIT, speaking generally, a man newly enlisted or enrolled in the armed forces of the country, to fill up a vacancy in an existing organization or toward the creation of additional organizations. In a more restricted sense of the term, a man enlisted or enrolled without previous military experience is and remains a recruit until his training has progressed to a stage which fits him to perform duty in the branch of the service to which he pertains. In soldier parlance, a raw recruit is called a rookie.

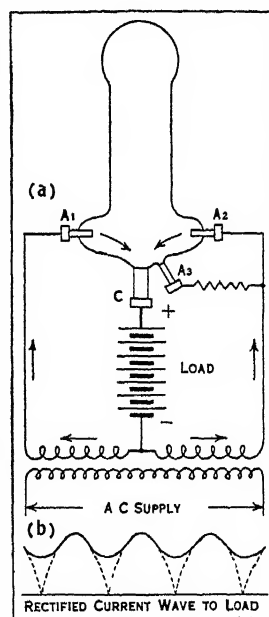
E. A. K.

RECRUITMENT. See ENLISTMENT.

RECTIFIER, a device for transforming an ALTERNATING CURRENT of any frequency into a direct or a pulsating current. Many kinds of rectifiers are in common use, the most important of which are discussed below.

Mercury-vapor Rectifier, also known as mercury-arc rectifier or converter, consists, as shown in the figure, of an evacuated glass bulb or an iron chamber with three principal electrodes of which one, *C*, is a small pool of mercury while the other two, *A*₁ and *A*₂ are of iron or carbon. A temporary arc between the mercury and a secondary electrode, *A*₃, vaporizes and ionizes (see IONIZATION) part of the mercury. The ions are drawn into the mercury and "splash" out electrons, which, along with some negative ions, are then drawn toward whichever of the other two electrodes happens to be positive. Some of the electrons in their motion upward ionize more mercury vapor near the mercury electrode and thereby produce new positive ions which "splash" out more electrons. The action then continues indefinitely. A unidirectional current flows through the branch, *C*. These rectifiers are in common use and tubes with as high a carrying capacity as 4,000 kilowatts are made.

Vacuum-tube rectifier, or thermionic rectifier, consists of an evacuated bulb with a tungsten filament which, when heated to redness, emits a cloud of electrons. When an alternating difference of potential is applied between this heated filament and a plate electrode, these emitted electrons are alternately forced either back into the filament or across the space between the filament and the plate electrode, depending on which, at any instant, happens to have the higher potential. A direct pulsating current then flows in the circuit during the intervals the electrons are being



MERCURY-ARC RECTIFIER

Showing (a) general arrangement and wiring diagram, (b) diagrammatic representation of pulsating current supplied to the load

forced to the plate. Such tubes are used for high-tension currents only and may have a carrying capacity of 10 amperes. Two such tubes may be so arranged as to supply an almost uniform current. Such tubes are also known as *kenotrons*.

The *tungar* is a modified form of this tube and contains some argon which is ionized by impact of the electrons. The negative ions then contribute to the electron flow to the plate. The tungar is commonly used for charging storage batteries.

The three-electrode vacuum tube (see TUBES, ELECTRONIC), when used as a DETECTOR in radio circuits, may be considered as one form of a rectifier.

Mechanical rectifiers employ a "reed" which vibrates between two fixed contacts in synchronism with the alternating current. The contacts join properly arranged connections so that the alternating current is always directed in the same direction through the part of the circuit in which the unidirectional current is desired. Such rectifiers have been made for currents as high as 500 amperes.

Electrolytic rectifiers consist of a solid conductor in an ELECTROLYTE, usually a rod of tantalum in dilute sulphuric acid in which a small quantity of ferrous sulphate is dissolved. The valve action depends on the gas-electrolyte boundary which allows the current to flow more readily in one direction than in the other. This form of rectifier is used for low voltages and small currents only.

Dry-Plate Rectifiers. Cone-shaped crystals of copper oxide, for example, conduct electrons about 1,000 times more readily in one direction than in the other. Such crystals, therefore, are employed as rectifiers of alternating currents. The active element consists of an oxidized copper plate which is treated to change the upper surface of the oxide to metallic copper. This forms a plate of two layers of copper which protect, and make electrical contact with, a thin layer of the crystals.

These rectifiers are used as "A"-battery eliminators in radio sets and carry small currents only. A. Z.

RECTOR (Latin, a ruler), the title of several classes of ecclesiastical and educational officials. The title, in its most ordinary clerical use, is applied to a clergyman who holds complete and independent charge of a parish. This use, however, is a departure from the canonical significance of the title, which meant rather a clergyman who was appointed to govern a parish where the chief parochial jurisdiction was vested in a religious corporation or in a nonresident dignitary. In certain monastic orders the title of rector is given to the superior of convents. It is also given to heads of universities and other educational institutions.

RECUPERATORS, metallurgical furnace auxiliaries which utilize hot flue gases to pre-heat the air supply. One type comprises two chambers of open brickwork, air passing through one and gases through the other alternately, the bricks acting to transfer heat. In a second type the hot gases circulate around the air intake pipes.

RECUSANTS, Roman Catholics, who, after the abolition of the papal jurisdiction in England in the reign of Elizabeth, refused to attend the services of the established Church. Elizabeth's excommunication and foreign plots against her resulted in legislation imposing on Roman Catholics penalties and disabilities which were not entirely removed until 1829.

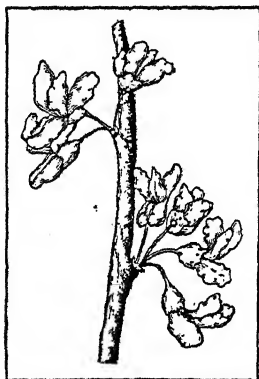
RED ARMY. After the disintegration of the imperial Russian army between the revolution of March and the Bolshevik *coup d'état* of Nov., 1917, the Soviets began the creation of the Red Army (so-called after the revolutionary color) by their decree of Jan. 15, 1918. It was first composed largely of disgruntled and demoralized elements, interspersed with a considerable number of Letts, Chinese and former German and Hungarian prisoners of war. When Trotsky took over the Soviet War Office in early 1918, he immediately undertook the organization of an efficient force, and by Nov. had a body of 500,000 men under arms. Large numbers of former imperial officers were assigned to commands. In their operations against the various White detachments, the Red troops generally gave proof of courage and loyalty; in the campaign of 1920 against Poland, however, the offensive was seriously weakened by wholesale desertions of both officers and men, and it is unlikely that in its formative period the Red force could have offered effective resistance against any well-armed, competently led and resolute foe of equal numbers. During the long period of comparative peace since the elimination of the Whites, the Soviet authorities have devoted immense energy to the development of the national army and to the training of communist officers, using German instructors to a large extent, particularly in aviation, which has been especially pushed. Despite its rapid strides in equipment and discipline, the contemporary Red Army remains an untried force, unquestionably weakened in morale to some extent by the grudging submission of numerous peasant members whose sentiments toward the whole organization differ but slightly from their elders' attitude toward the old imperial military machine. The Red Army constitutes, however, a favored section of the population, and every possible effort is expended to keep it well-fed and contented. The current contingent is based upon universal service, and its present enlisted strength is 562,000.

S. H. C.

RED BANK, a borough of Monmouth Co., N.J., situated on the banks of the Navesink River, an estuary of the Atlantic Ocean, 25 mi. by air and 49 mi. by rail south of New York City. Its transportation facilities include the Pennsylvania and Central of New Jersey railroads and numerous motor bus lines; it has a fully equipped airport. A suburban residential community and summer resort, Red Bank is the trading center for a district of fine country residences and estates. It has several important industries, including the manufacture of clothing and uniforms and the building of boats. The retail trade in

1929 amounted to \$13,545,147. Red Bank was settled about 1780 and was separated from Shrewsbury township in 1870, when it was incorporated. Pop. 1920, 9,251; 1930, 11,622.

REDBREAST, a small song bird (*Erithacus rubecula*), belonging to the thrush family of western Europe. Its upper parts are blue and brown; forehead and breast orange-rufous and belly white. It has for ages attached itself to man, and around it has accumulated a delightful cluster of stories, poetry and legends, associated with domestic cheer. Hence it has given its name, robin, to many a familiar bird all over the world, including the American thrush with the red breast. The redbreast's sweet and lively warbling is heard the year round. "He is a welcome singer in every home in the Kingdom," writes a British observer, "trusting us as few of our native birds do. It is in winter, perhaps, that we know him best; however cold and stormy the weather, he always appears happy, cheerful and sprightly, as he hops along the garden-path, or seeks his breakfast at the dining-room window, returning thanks by a short but brilliant outburst of song." E. I.



COURTESY IOWA GEOL. SURV.

REDBUD

(*Cercis canadensis*). Flowering branchlet, three-fourths natural size

REDBUD, a name commonly applied in North America to the native species of *Cercis*, highly ornamental trees of the pea family, bearing showy red or pink flowers which appear before the leaves. See **JUDAS TREE**.

RED CROSS, AMERICAN, an organization first started in 1881 as the American Association of the Red Cross. As early as 1866,

a tentative society had been formed by the Rev. Henry W. Bellows, president of the U.S. Sanitary Commission which served in the Civil War; but it was not until May 21, 1881 that Clara Barton and others formed the American Red Cross.

In 1905, the society was completely reorganized on an extensive plan under a Congressional charter, with William Howard Taft as president. By this charter it became a semiofficial arm of the government, the President naming one-third of the members of the Central Committee, the chairman included, and the War Department auditing the financial accounts. Maintenance funds are obtained by an annual Roll Call. The society has a normal membership of 4,000,000 throughout the United States and possessions.

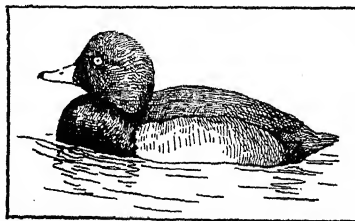
Red Cross services include disaster relief, war service, volunteer services of various kinds, including production of garments, nursing service with an enrolled reserve of 52,000 registered nurses, home hygiene and care of the sick, nutrition, first aid and life-saving and the Junior Red Cross which has a membership of

nearly 7,500,000 children in the schools. National headquarters are in Washington, D.C. M. T. B.

REDEMPTORISTS, missionaries of the Congregation of the Most Holy Redeemer, founded in 1732 in the vicinity of Naples, Italy, by St. Alphonsus Liguori. In 1749 the Church received the approbation of Benedict XIV, and in spite of many obstacles spread successively beyond Italy into Poland, Germany, Switzerland, Austria, Portugal, Belgium, Holland, North America, France and the British Isles. The political upheavals of the middle of the 19th century retarded the progress of the congregation; but foundations were subsequently made in Spain and South America, where at Surinam the missionaries worked among lepers. In Canada the Redemptorists have had charge of the shrine of Ste. Anne de Beaupré since 1878. Other countries having Redemptorist establishments are the United States, Denmark, Australia, New Zealand, the West Indies, the Philippines, South Africa and Asia Minor. There were 310 houses and about 5,300 religious in 1931. Redemptoristines, nuns forming a contemplative branch of the congregation, numbered approximately 1,000 in 27 convents, with the mother-house at Scala, Italy.

REDFISH, a name applied to various unrelated fishes because of their coloration, as the blueback salmon (*Oncorhynchus nerka*), rock sea bass (*Triloburus philadelphicus*), red drum (*Sciaenops ocellata*), and rosefish (*Sebastes marinus*).

REDHEAD (*Nyroca americana*), a diving duck closely allied to the canvasback and, like it, highly prized as a game bird. It ranges throughout North



DRAWING BY GEORGE MIKSCH SUTTON

REDHEAD

America breeding from California and Wisconsin northward and wintering southward to central Mexico. The redhead is about 19 in. long, the male having a reddish head and neck, dark gray back, black chest and white underparts; the female is chiefly grayish brown. In both male and female the bill is pale blue tipped with black. The redhead frequents large lakes, bays and rivers, diving to great depths to feed upon various aquatic plants. When subsisting upon wild celery, as it does in great numbers in the Chesapeake Bay in winter, its flesh rivals that of the canvasback in delicacy. The nest, in which are laid 6 to 18 buffish eggs, is made of weeds lined with white down, and is placed in the reeds, usually over water.

REDHORSE, the common name for a genus (*Moxostoma*) of soft-rayed fishes of the **SUCKER** family (*Catostomidae*). There are about 20 species, all found

in the central and eastern United States. The common redhorse (*M. aureolum*), sometimes 2 ft. long, olive-colored with the sides silvery and the lower fins red, is the most important food fish of the group.

REDISCOUNTING, the process whereby a bank lends money by purchasing a bill of exchange and subtracting the interest in advance. The bank sometimes endorses this bill and sells it to a DISCOUNT CORPORATION or the CENTRAL BANK. It is one of the most important functions of the central bank in every country to make such credit available to commercial banks, and the rediscount rate is one of the most important indicators of the state of the money market. The FEDERAL RESERVE ACT and the Federal Reserve Board sets the standard for eligibility of paper which will be accepted at the Federal Reserve banks, as to maturity, and as to the nature of the transaction giving rise to it. The Reserve banks also have definite standards by which to judge the credit standing of the makers of such paper. The rate of rediscounting is set by the Reserve banks with the approval of the Board. In the United States, due to peculiar American conditions, the type of paper presented for rediscounting is the endorsed promissory note, rather than the BANKERS' ACCEPTANCE or TRADE ACCEPTANCE popular abroad. B. H. B.

REDLANDS, a city in San Bernardino Co., southern California, situated on the Santa Ana River, 67 mi. east of Los Angeles, served by two railroads, the Pacific Electric Railway and by buses. Redlands is a shipping point in one of the largest citrus fruit-growing regions in the world. Deciduous fruits, poultry, bees, hogs, rabbits and dairy products are also important interests of the district. The city has large fruit canneries. The retail trade in 1929 amounted to \$10,627,822. The Spaniards built a mission here in 1810. New Englanders settled Redlands in 1887, and a year later the city was incorporated. It is the seat of the University of Redlands, established in 1907. The setting of the city is especially beautiful. The mountains, San Jacinto, Old Baldy or San Antonio, San Bernardino and San Geronimo lie within easily accessible distances. Pop. 1920, 9,571; 1930, 14,177.

REDLANDS, UNIVERSITY OF, at Redlands, Cal., a coeducational and privately controlled institution affiliated with the Baptist Church, was incorporated in 1907. It had an endowment in 1931 of \$3,133,116. The library, which contains 33,481 volumes, is a depository for the A. K. Smiley Library of Redlands. In 1931-32 there were 598 students and a faculty of 50, headed by Pres. Victor Leroy Duke.

RED MEN, IMPROVED ORDER OF, a fraternal and beneficial society, organized in 1833 as an outgrowth of the Sons of Liberty. Its ritualistic forms are based on the customs, language and traditions of the North American Indians, though only white persons are admitted to membership. The government has been organized into local "tribes" with the governing power vested in the Great Council of the United States. The officers are called the Great

Incohonce, the Great Senior Sagamore, the Great Chief of Records, and the Great Keeper of Wampum, or treasurer. Each member, or adopted pale face, is required to have the name of an animal or bird.

Branches of this order have been established in every state of the United States, as well as in Canada. The total membership is above 360,000. There are three degrees conferred, Adoption, Warrior and Chief; women may belong to the degree of Pocahontas. The society's motto is, "Freedom, Friendship and Charity."

RED OAK, a city in southwestern Iowa, the county seat of Montgomery Co., situated on the Nishnabotna River, 55 mi. southeast of Omaha, Neb. The Chicago, Burlington and Quincy Railroad serves the city. Red Oak is surrounded by a fine grain growing region. Calendar making is the most important industry. Other manufactures include flour, canned vegetables, bridges and iron products. The city has a commission-clerk government. Red Oak was founded about 1854, and incorporated in 1876. Pop. 1920, 5,578; 1930, 5,778.

REDONDA, a British island of the West Indies, lying 25 mi. southwest of ANTIGUA. It is included in the dependency of Antigua, which forms part of the LEEWARD ISLANDS colony. The island has a total area of ½ sq. mi. and springs from the sea in a single mountain 1,000 ft. high. It contains deposits of phosphate of alumina which are exploited and exported to the United States. Pop. about 200.

REDONDO BEACH, a beach city in Los Angeles Co., southern California, 19 mi. southwest of Los Angeles. It is four mi. from Los Angeles Municipal Airport and is served by bus lines, the Santa Fe Railroad and the Pacific Electric Railway. Truck farming is the leading interest of the countryside. Redondo Beach is built in a picturesque natural amphitheatre, rising 250 ft. from the beautiful crescent-shaped beach, and is a delightful resort and residential community for the neighboring industrial towns and oil fields. It is the seat of three military schools. The city has a large, warm, salt-water bathing-pool. The site was discovered in 1542 by Juan Rodriguez Cabrillo, the Portuguese navigator. It was incorporated in 1892. Near by are ancient Indian burial grounds. Pop. 1920, 4,913; 1930, 9,347.

REDOUBT, a closed or semi-closed defensive fortification located on a strategic strong point with wide field of fire and bearing a mutually interdefensive relation to other works or to natural barriers to hostile progress. It is usually flanked by trenches and protected by wire entanglements.

REDPOLL, the common name for a genus (*Acanthis*) of small birds of the finch family (*Fringillidae*) closely allied to the linnets. The plumage of the male is streaked chestnut, dusky brown and white, with a rosy breast and a characteristic bright red crown; that of the female lacks the rosy coloration on the breast. There are several species, mostly inhabiting high northern regions. The best known is the common redpoll (*A. linaria*), breeding around the world in arctic and boreal regions and migrating in North

America irregularly southward as a winter visitor as far as Illinois and Virginia. It builds a compact, well lined nest in a grass tuft or low bush, laying four to six spotted whitish eggs, and feeds largely upon seeds.

RED RIVER, the southernmost large tributary of the Mississippi, rising in the Staked Plains of north-western Texas. Its course for several hundred mi. is a little south of east, forming the northern boundary of Texas and flowing into Arkansas. At Fulton it turns southeast and maintains that general direction across Louisiana to its junction with the Mississippi at Red River Landing. This stream is 1,275 mi. long and drains an area of 66,000 sq. mi. It is an aggrading river since it is heavily charged with sediment and has a very gentle slope averaging less than 1 ft. per mi. Originally its channel for 92 mi. from Loggy Bayou to Hurricane Bluffs was filled at intervals with a mass of sunken logs and stumps known as the Great Raft. The head of navigation was at the foot of this raft, 257 mi. from the river's mouth. By clearing the banks and by dredging, the channel has been improved to prevent formation of rafts and to open navigation to Fulton, Ark., a distance of 515 mi. The largest affluents of the Red River are the Ouachita, Little River, Peace and Big Wichita. The important cities situated on it are Shreveport, Natchitoches and Alexandria, La.

RED RIVER OF THE NORTH, a river of Minnesota and Canada, formed at Breckenridge, Minn., by the junction of nearby lake outlets. The stream flows generally north, establishing the boundary between Minnesota and North Dakota and enters Canada. It continues north to Winnipeg where it receives the Assiniboine from the west and the combined stream flows into the sound end of Lake Winnipeg. The basin of the Red River, which is noted for its fertility, was formerly the bed of Lake Agassiz. It has an average width of 30 to 35 mi. throughout the 545 mi. of the river's course. There is a considerable difference in latitude between the upper and lower reaches of this river and in some years spring begins at the former while the latter is icebound, causing the upper water to overflow. Its chief tributaries are the Buffalo, Red Lake and Two Rivers from the east, and the Pembina, Goose and Sheyenne from the west. Fargo, N.D., and Moorhead, Minn., are situated on its course.

RED RIVER REBELLION, 1869-70, in Canadian history, the insurrection of the French-speaking inhabitants of the RED RIVER SETTLEMENT following the NORTHWEST TERRITORY PURCHASE. The Métis (half-breeds), comprising 10,000 of the 12,000 inhabitants of the region, derived first impressions of changed conditions from the entrance of Government surveyors before the Government had taken formal title to the territory, and of land speculators who followed the surveyors. The rectangular system of survey applied by the Government did not jibe with and disregarded the bounds of the inhabitants' farms; the Métis feared confiscation. Louis Riel, visionary

and fanatic, became spokesman for the discontented. Bishop Taché, who could have supplied the tact which the Government did not vouchsafe, was absent in Rome. In Oct. 1869, Riel organized the Métis and halted the surveying activities; on Nov. 2 his agents forced William McDougall, appointed lieutenant-governor of the province, to retire across the international boundary. Riel's forces on Nov. 1 occupied Ft. Garry, and armed themselves from the fur company's stores. An election of delegates was called by the "President (Riel) and Representatives of the French-speaking population of Rupert's Land in council." The English speaking inhabitants decided to send delegates also, whereupon Riel seized the records of the council of Assiniboia, and began a provisional government. On Dec. 1 a bill of rights was adopted, asserting the right to elect a legislature; to establish a public land policy; and to appropriate public lands for schools, roads, bridges and parish buildings; and demanding a railway linking Winnipeg with the nearest existing railway, the use of French and English languages in legal parity, and full representation in the Dominion Parliament. These resolutions furnished a basis of negotiation. Three commissioners from the Canadian Government, Vicar-General Thibault, Col. de Salabery and, most important, Donald A. Smith (later BARON STRATHCONA), met 40 delegates from the Red River Settlement in conference, Jan. 25-Feb. 11, 1870. Smith answered each demand of the Bill of Rights apparently acceptable. Riel, who had lately assumed the title of president, released some of the 60 Canadians arrested for opposing the provisional government, and promised the release of all. Riel precipitated a crisis, however, in directing the trial of Thomas Scott, a young Canadian, on the charge of having resisted the provisional government and striking an officer of the guard. Following arbitrary proceedings, Scott was executed the same day, Mar. 3. Archbishop Taché arrived at Ft. Garry four days later, and to quiet the settlers promised amnesty for the slaying of Scott. Premier Macdonald secretly forwarded funds to induce Riel to exile himself. The provisional legislature organized by Riel resolved to accept the Manitoba act and enter the Dominion under its terms; but ill-feeling smouldered for several years.

RED RIVER SETTLEMENT, in Canadian history, the first agricultural colony established west of Upper Canada. Lord Selkirk, philanthropist and expansionist, in 1811 purchased a controlling interest in the HUDSON'S BAY COMPANY, thereby assuring the validity of his earlier purchase of 116,000 square miles of the company's lands along the Red River. In 1811 Selkirk dispatched to the district, named by him Assiniboia, the first contingent of colonists, Scottish Highlanders, with a few Irish from Sligo. By 1815 three successive contingents of Highlanders had arrived. These original elements were shortly outnumbered by half-breeds, the *métis*. The opposition of the Northwest Co. traders to an agricultural settlement in the West, based on fear of the depletion of

buffalo and fur-bearing animals, culminated in the Battle of Seven Oaks. Lord Selkirk refused to grant title to land except on promise to abstain from the fur trade; but agricultural activities were augmented by speculative enterprises, notably buffalo wool and tallow companies. The main source of income of the *métus*, indifferent farmers, was the provisioning of the Hudson's Bay Co. with pemmican and other preparations of buffalo. Selkirk himself was in the settlement only during part of 1817; his heir in 1834 conveyed control of Assiniboia to the Hudson's Bay Co.

RED SEA, an arm of the Indian Ocean, separating the Arabian peninsula from the northeastern coast of Africa. It measures about 1,200 mi. from northwest to southeast, has a maximum width of 200 mi., and an area of almost 200,000 sq. mi. At its southeastern extremity it communicates through the Strait of Bab el Mandeb with the Gulf of Aden before reaching the Indian Ocean, and at its northwestern end it connects with the Mediterranean through the Suez Canal. Its waters have a high salinity and are comparatively shallow except in the central channel where there is a maximum depth of 7,740 ft. The Red Sea has long been an important trade route between India and Mediterranean lands.

RED SHIRTS. See GARIBALDI, GIUSEPPE.

RED SNOW, a minute one-celled alga (*Sphaerella nivalis*) which, although of microscopic size, grows in such numbers as to form brilliant scarlet patches on the surface of snowfields in Greenland and other arctic regions and also on high mountains. See also ALGÆ.

RED SPIDER, the popular name for members of a family (*Tetranychidae*) of mites, which are often pests on cultivated plants, fruit trees and bushes, on the juices of which they live. Twenty species are found in America. The most familiar are the common red spider (*Tetranychus bimaculatus*) and the clover mite (*Bryobia pratensis*). The former is red or yellow in color, and occurs both in gardens and greenhouses. It spins a web for its eggs on the under side of leaves. The latter is always red, and lives on clover and fruit trees, where its red eggs may be found in winter. Frequently it enters houses to hibernate.

RED SQUARE, a space in the inner city of Moscow, to which the Iberian Gate, with its historic shrine, has been a principal entrance. Surrounding it are the battlemented east wall of the Kremlin, entered through the famous Gate of the Redeemer, the Historical Museum, Kazan Cathedral, the trading rows and the Cathedral of St. Basil. Here were proclaimed the edicts of the ancient tzars while terrible memories became associated with it as a place of execution, especially as the scene of many of the cruelties of Ivan the Terrible and of the orgies of bloodshed carried out by Peter the Great after the revolt of the Streltsi. In the transformation wrought by the Bolsheviks the tomb of Lenin has been added to the historic monuments of the Red Square, the

Gate of the Iberian Virgin has been removed and St. Basil's is used mostly as a museum.

REDSTART (*Setophaga ruticilla*), a small handsome bird of the wood warbler family (*Comptosiidae*), found in woodlands almost throughout North America, wintering chiefly in the West Indies and Central America. It is about 5½ in. long, black above and white below with bright orange markings on the sides, wings and tail. The redstart is restless and active, capturing insects on the wing with the agility of a flycatcher, and has a wiry song, similar to but shorter than that of the yellow warbler. It nests in a tree-fork laying four or five spotted whitish eggs. The Old World redstarts (*Phœnicurus* sp.) belong to the thrush family.

REDTOP, one of the various names applied to the fiorin (*Agrostis palustris*), a common pasture and meadow grass native to Europe and widely naturalized in North America. See BENT GRASS.

REDUCTION, a chemical process consisting in a decrease in the positive VALENCE or an increase in the negative valence of an element. It may be defined as that process by which an atom, or ion, gains ELECTRONS. Thus ferric chloride (FeCl₃) may be reduced to ferrous chloride (FeCl₂), in which case the ferric ion with a valence of plus three, gains one electron and is so transformed into a ferrous ion with a valence of plus two. Likewise, in the refining of copper, copper sulphate (CuSO₄) is electrolytically reduced to metallic copper. In this process the cupric ion, with a valence of plus two, gains two electrons and is so reduced to elementary copper with a valence of zero. See also OXIDATION AND REDUCTION.

REDWING, a handsome species of BLACKBIRD nesting abundantly in marshes in the eastern United States and southern Canada.

RED WING, a city in southeastern Minnesota, the county seat of Goodhue Co., situated on the Mississippi River, 41 mi. southeast of St. Paul. Bus lines and two railroads serve the city, which formerly was a shipping center for wheat. There are various manufactures including marine engines, pottery ware, sewer pipe, flour, shoes and malt. Red Wing was a village of the Dakota Indians. Swiss missionaries arrived in 1837; the city was laid out in 1853 and chartered in 1857. It was named for an Indian chief who lies buried on Barn Bluff. Pop. 1920, 8,637; 1930, 9,629.

REDWOOD, a name applied to various woods yielding a red dye and also to numerous trees producing timber of a reddish color. Among the red dye-woods are brazil wood, sapan wood, Limawood, camwood, and red sandalwood. Among the red timber woods are the mahogany (*Swietenia Mahagoni*), the European dogwood (*Cornus mas*), the rohan (*Soyimida febrifuga*), and the Asiatic buckthorn (*Rhamnus Erythroxylon*). The valuable Pacific Coast redwood is a species of SEQUOIA.

REDWOOD CITY, a town in western California, the county seat of San Mateo Co., situated on Redwood Creek, near San Francisco Bay, 25 mi. southeast of San Francisco. The city is served by the Southern

Pacific Railroad. Flowers, fruit and truck crops are produced in the vicinity. Redwood City has fruit canneries and factories manufacturing leather, magnesia and rubber products and cement. It is a popular pleasure resort. Some distance south lies Big Basin State Redwood Park. Pop. 1920, 4,020; 1930, 8,962.

REED, JAMES A. (1861-), American political leader, was born near Mansfield, O., Nov. 9, 1861. He moved with his parents to Linn Co., Ia., in 1864. After attending public schools and Coe College at Cedar Rapids, Ia., he studied law. He was admitted to the bar in 1885 and commenced practice in Cedar Rapids. He moved in 1887 to Kansas City, Mo., where he continued the practice of law with unusual success. As a Democrat he occupied several local offices—counselor of Kansas City 1897-98, prosecuting attorney of Jackson Co. 1898-1900, and mayor of Kansas City, 1900-04. Reed, regarded as a reform-mayor, compelled the various public utilities of Kansas City to introduce changes which benefited the inhabitants. An ardent Democrat, he was a delegate to the Democratic National Convention in 1908, 1912, 1916, 1924, and 1928. Elected to the U.S. Senate in 1910 he served for three terms from Mar. 4, 1911 to Mar. 3, 1929. He was one of the group of senators who opposed with or without reservations, the Versailles Treaty with its entailed membership in the League of Nations. In 1929 he resumed law practice in Kansas City.

REED, THOMAS BRACKETT (1839-1902), American legislator, was born in Portland, Me., Oct. 18, 1839. He attended the public schools and was graduated from Bowdoin College in 1860. He studied law and taught school for four years in Portland before becoming an acting assistant paymaster in the U.S. Navy Apr. 19, 1864, serving until Nov. 4, 1865. He was admitted to the bar in 1865 and began practice in Portland.

Entering politics as a Republican he occupied a number of state offices, member of the Maine House of Representatives 1868-69; state senator, 1870; attorney-general of Maine, 1870-72; and city solicitor of Portland, 1874-77. He was elected to the national House of Representatives in 1876, and was reelected for 11 successive terms, serving from Mar. 4, 1877 until Sept. 4, 1899 when he resigned. He was speaker of the House 1889-91, and 1895-99. Reed possessed an astonishing mass of factual information which he used readily in debate. A master of clear, effective English, he had a penetrating alert mind, and an irrepressible desire to mock the remarks of confused or verbose congressmen. His sarcastic sneers which frequently interrupted speakers produced constant merriment in the house and yet made enemies of the victims of his ridicule. A huge man, Reed had a manner of drawling his remarks which particularly offended the objects of his witticisms.

Almost from the beginning of his service in the House, he was recognized as a Republican leader. In all partisan issues he invariably supported the stand of his party. His chief fame came as speaker of

the House from 1889-91. The Democrats, slightly outnumbered by the Republicans, as an obstructionist policy to block the passage of Republican legislation would not answer roll-call and thus would prevent the quorum necessary for legislation. Reed instructed the clerk to mark as present those who were in the chamber whether they answered or not. He, furthermore, refused to permit motions when the obvious intent was to delay proceedings. The House was in an almost continuous uproar of protest but the speaker finally triumphed in his contention that "The object of a parliamentary body is action, and not stoppage of action." The following term the Democratic majority organized the House and Reed used against them their former obstructionist tactics so effectively that the Democratic speaker adopted the previously denounced "Reed rules." In 1892, Reed was a candidate for the Republican presidential nomination but withdrew upon Blaine's hasty candidacy a few days before the convention. Reed was again a candidate in 1896 and was bitterly disappointed at his failure. Extremely unsympathetic to McKinley's imperialistic policies after the Spanish War, he retired from public life and began a lucrative law practice in New York City. He died in Washington, Dec. 7, 1902.

S. McK.

BIBLIOGRAPHY.—W. A. Robinson, *Thomas B. Reed, Parliamentarian*, 1930.

REED, WALTER (1851-1902), American bacteriologist, was born in Gloucester County, Va., Sept. 13, 1851. He was educated at the University of Virginia and Bellevue Medical School, receiving his M.D. degree in 1870. In 1874 he entered the medical corps of the U.S. Army and received several promotions. When the Spanish-American War broke out, he was appointed chairman of a committee to investigate typhoid fever, and his report on this subject revealed a number of points heretofore not known. In 1899, when yellow fever was prevalent in Cuba, he was again appointed head of a commission to investigate its cause and method of transmission. Reed and his associates soon discarded the view that the disease is transmitted by fomites in bedding and clothing, and revived the belief of Finlay that the disease is transmitted by the mosquito. They established definitely the method of transmission of yellow fever, and through their work sanitary engineers in Cuba were able to eradicate the disease, and a case of yellow fever is now a rare occurrence in any civilized country. Walter Reed died in Washington, D.C., Nov. 23, 1902.

M. F.

REED, the common name applied to various tall grasses found chiefly in marshy places. The common reed (*Phragmites communis*) grows almost throughout the world from the tropics to the arctic zone. It is a stout perennial, rising from creeping rootstocks sometimes 20 or 30 ft. long, with hard, almost woody stems 5 to 10 ft. high, bearing numerous broad leaves and a large purplish-brown flowering panicle. The giant reed (*Arundo Donax*), the largest of European grasses, with somewhat woody stems 6 to 20

ft. tall, is often planted for ornament. The woody stems are used for reeds of clarinets and for making walking sticks and fishing rods. In the United States the small cane (*Arundinaria tecta*) is called reed. The marram or beach grass (*Ammophila arenaria*) is also known as sea reed.

REEDBUCK (*Redunca arundineum*), called also reitbok, a small but handsome antelope of South Africa, which haunts the reedy borders of rivers or marshland, never being found far from water. It stands 3 ft. high at the shoulders and is about 4 ft. long. The tail is bushy and there is a bare gland patch behind each ear. The male alone possesses horns, which curve forward in a hook. The general color is like that of a red fox, but is sometimes much paler. When alarmed the reedbuck whistles like the chamois, but being unsuspicious and slow of foot, it has become rare.

REEF, a rocky or sandy ridge, rising almost to, or slightly above the surface of the sea. Sand reefs, raised by the waves into offshore bars, or barrier beaches, border the Atlantic coast of the United States from New Jersey to the Rio Grande. Sandy Hook outside New York harbor is such a sandy bar. Coral and other lime-secreting organisms form reefs near the shores in warm seas. Submerged rocks, constituting a serious menace to navigation, are usually crowned by lighthouses. See also CORAL REEF.

REESE, LIZETTE WOODWORTH (1856-), American poet, was born in Baltimore Co., Md., Jan. 9, 1856. She taught English in the Western High School, Baltimore, for many years, retiring in 1921. A bronze tablet inscribed with *Tears*, her best known poem, was erected at this school in 1923. Her many volumes of poems include *A Branch of May*, *A Quiet Road*, 1916, *Spicewood*, *Wild Cherry*, 1923, and *Little Henrietta*, 1927.

RE-EXPORTS. See EXPORTS AND IMPORTS.

REFERENDUM, a term given to the practice of referring bills passed by the legislature back to the people for approval or disapproval. The referendum may be optional or compulsory. If optional, it operates when a fixed number of citizens sign a petition requesting the legislature to submit a particular measure to them. If compulsory, certain measures must by constitutional mandate be referred to the people for their approval or disapproval. Although the referendum was developed in Switzerland, it occurs in many states of the United States, in the English dominions, and in a number of European countries, particularly those whose constitutions were altered during the postwar transformation. It is a device whereby the citizens of a representative democracy can take direct action.

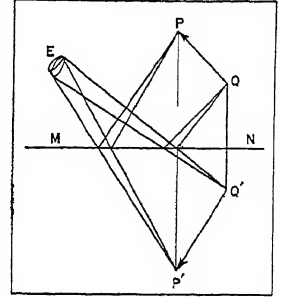
S. C. W.

BIBLIOGRAPHY.—A. Holcombe, *State Government*.

REFLECTION, the turning back into its original medium of the energy of any kind of wave upon its arrival in another medium. Two laws govern this action: the angle of reflection equals the angle of incidence, the angles being measured with respect to the normal to the surface at the point of incidence; and

the incident ray, the reflected ray and the normal lie in the same plane.

In the case of rough bodies, diffuse reflection, or scattering, occurs. In the case of plane MIRRORS, reflection gives rise to a virtual image located as far behind the mirror surface as the object is in front. The image can be constructed by noting that a bundle of rays from *P* (see figure) coming by way of the mirror, *MN*, to the eye, *E*, seem to come from a point, *P'*, where the bundle of rays meet when projected backward. So each point on *PQ* from which a ray comes has a corresponding point on *P'Q'* where the virtual image lies. (See REFLECTION OF RAYS FROM P BY MIRROR MN GEOMETRICAL OPTICS.)

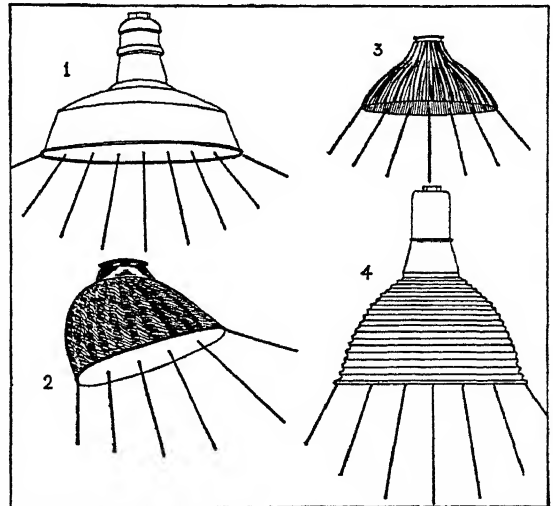


The laws of reflection given above are not dependent on any theory as to the nature of light, and may be explained equally well by the wave theory or the corpuscular theory. In the latter theories, now abandoned, the behavior of the particles is assumed to be in accordance with the laws of mechanics, so that the action would be similar to that of billiard balls. See also WAVE MECHANICS.

P. I. W.

BIBLIOGRAPHY.—Houstoun, *Treatise on Light*.

REFLECTORS, appliances, the chief use of which is to redirect the light of a lamp by reflection in a desired direction or directions as shown in the illus-



COURTESY WESTINGHOUSE LAMP CO

TYPES OF REFLECTORS

1, Porcelain enameled steel; 2, mirrored glass; 3, prismatic glass; 4, polished metal

tration. In automobile HEADLIGHTS and in SEARCHLIGHTS, reflectors of polished metal or mirrored glass provide accurate control and concentration of the light. For industrial applications steel reflectors with a porcelain-enamel surface shield the light source and diffuse the light rays, reflecting them in a general down-

ward direction. Prismatic and opal glass are also used in reflectors.

REFLEX, a type of radio circuit in which one or more tubes (*see* TUBES, ELECTRONIC) are used for two independent purposes, such as AMPLIFICATION of the RADIO FREQUENCY signal and of the AUDIO FREQUENCY current.

REFLEX ACTION. *See* SPINAL CORD.

REFORMATION, THE. The Protestant Reformation of the 16th century permanently broke the unity of the medieval Church in the West. The revolt had long been in preparation, and many factors contributed. There were political causes. Emergent nationalism cut athwart the universalism of the medieval Church. At the opening of the 16th century France, Spain and England were consolidated under strong monarchies, and the nationalization of the Church was taking place even in countries unaffected by Protestantism. There were judicial abuses in the handling of wills, matrimonial cases, the crimes of clerics and the right of asylum. In legal theory the revived study of Roman law favored state churches rather than the medieval theocracy, and stimulated social revolt by substituting a theory of absolute ownership for one of communal property. Economic factors contributed. Financial independence would have enabled the papacy to resist the nations; but instead direct appeals and tortuous devices for raising money produced constant resentment, especially in Germany where the absence of a national Government left the most flagrant abuses unredressed. The method of granting indulgences was frequently the subject of attack by the reformers. The monastic orders created an economic problem, not only because of their wealth, but even more when voluntary poverty bred indolent beggars. There were moral causes. The popes of the Renaissance could not be distinguished from the contemporary Italian despots in cruelty, unscrupulousness, military prowess and sexual laxity. Clerical concubinage was not suppressed, but taxed. There were religious causes. The cult of the saints, the veneration of relics, religious pilgrimages, the cruelty of the Inquisition, the exaltation of the religious above the secular and of the cleric above the lay, the claim to religious authority on the part of those whose lives belied their vows, the external and the magical in religion, all these occasioned criticism.

There had been many previous revolts. The Waldensians emphasized lay preaching and Biblical authority. The Spiritual Franciscans called the Pope a heretic because of his declaration that Christ was not absolutely poor. JOHN WYCLIFFE and the LOLLARDS in England attacked transubstantiation and held that property is merely a trust from God forfeited in case of abuse. If the Church were faithless to the trust she might be despoiled by the state. JOHN HUSS in Bohemia added to these teachings of Wycliffe a demand that the cup as well as the bread be given to the laity in the celebration of the mass, and attacked indulgences. His followers, the Taborites, introduced communism. Political thinkers, like Marsilius of

Padua, demolished the theory of the medieval papacy. All of these movements, though crushed, contributed in a measure to the Protestant Reformation.

More influential were two developments within the Church, namely northern mysticism and humanism. In the Germanic lands, the Friends of God and the Brethren of the Common Life cultivated an inward religion which nourished itself on the rites of the Church, but might readily have dispensed with them. Christian humanism, personified by DESIDERIUS ERASMUS, satirized popular superstitions, and by the publication of the New Testament and of the Patristic writings in the original tongues called attention to the discrepancies between the medieval and the early Church. Both movements contributed to religious liberty, the first by making religion an inward thing which cannot be forced, the second by substituting enlightenment for constraint.

Martin Luther. The Protestant Reformation was begun by MARTIN LUTHER, an Augustinian monk and a professor at the University of Wittenberg in Electoral Saxony. He had commenced with the problem of the salvation of his own soul. Aided by the mystics he came to see that the just shall live not by anything they can do, but solely by their faith in the grace of God made available through the work of Christ. This principle of justification by faith cut the ground from under the indulgence traffic, based on the assumption that the treasury of the merits of the saints may be used to cover the deficits of those in purgatory. Luther in his 95 theses of 1517 denied the treasury. The newly invented printing press disseminated his views. Nationalists and Humanists supported a reform which was entirely religious in its inception.

The question of indulgences soon became subordinate. By 1520 Luther was asserting the sole authority of Scripture; the priesthood of all believers; that the sacraments are two only, baptism and the Lord's Supper; that without transubstantiation the body of Christ is physically present in the elements; that the mass is not a sacrifice; that the pope should be merely the spiritual head of Christendom and temporals should be administered by national churches. In 1520 Luther was placed under the ban of the Church. He replied by burning the bull of excommunication together with the canon law. The next year he was placed under the ban of the empire, but was never molested, partly because the disorganized state of Germany enabled his own prince, Frederick the Wise, to accord him protection without interference, partly because the Emperor Charles V was occupied in wars with the Pope, the French and the Turks, partly because Luther came to be recognized as a moderate restraining the more radical elements in his own movement.

Protestantism soon developed a left wing. Carlstadt was urging a speedy, violent, Puritanic *הפכה*. Thomas Munzer at first stressed the *הנהגה* the Spirit above the letter of Scripture and the bearing of the cross rather than faith as the way of salvation,

but later for the way of the cross he substituted a social revolution for the eradication of the grinding poverty which precludes any knowledge of the Scripture. Munzer threw himself into the Peasants' Revolt, 1525, which Luther so bitterly condemned. The revolt was crushed. The peasants were alienated from the Lutheran movement, and Luther was left with the conviction that religious radicalism must issue in social revolution. Against such tendencies he invoked the authority of Scripture, Christian tradition, clerical leadership, and state intervention for the repression of heresy and for the organization of the Church. Theology grew more rigid and issued in the doctrine of predestination which served as a powerful weapon against the authority of the Catholic Church, but alienated the Humanists. Erasmus became an enemy without and PHILIP MELANCHTHON an embarrassment within the movement. On one point Luther did not retrogress, namely in his criticism of the whole monastic system. Man's divine calling is not in the cloister, but in the common occupations of life, not in the celibate state, but in matrimony. Luther, himself an ex-monk, married an ex-nun. The breach with Catholicism was complete. Luther started out to save his soul, threatened to reform Christendom and ended by founding a sect.

In the meantime at Zurich, ULRICH ZWINGLI by stages, 1519-25, established a Protestant theocracy, in which the ministers, like Samson of old, should lead the entire commonwealth. This union of Church and State, though more intimate than the Lutheran, was less perilous to the Church, because of the democratic organization of the state. The death of a prince could not bring a change in religion.

Anabaptists. The Anabaptist movement (*see* ANABAPTISTS) began in Zurich in 1520 because of disillusionment over the failure of the Reformation to produce any far-reaching moral transformation. Luther and Zwingli, like the Catholics, thought of the Church as an ark of salvation including all the members of the community, baptized in infancy. The moral offender should not be lightly expelled since he cannot be saved without. The Anabaptists thought of the Church as a community of the saints, composed of those who have made a personal confession through adult baptism. The unworthy must be rigidly excluded. Against the Anabaptists, Catholic and Protestant alike in 1529 revived the old imperial law which visited the death penalty upon those who re-baptized heretics returning to the Church. All of the really able Anabaptist leaders were executed in a few years and the movement in the main fell into less competent and less sober hands. The sect spread down the Rhine into the Netherlands and northern Germany. At Munster in Westphalia the fanatical party staged a brief kingdom of the saints with the introduction of Communism and polygamy, 1533-35. The Anabaptists as a whole were a peaceable folk, austere, mainly unlettered, opposed to war, to capital punishment and to the taking of oaths. Anabaptism was an attempt to practice the asceticism

of monasticism without abandoning the world. The literature of the movement is only beginning to be published.

Calvinism. JOHN CALVIN combined the territorial and the confessional theories of the Church. All who live in the community are members of the Church by virtue of a personal confession, because those who refuse the confession leave the community. Geneva was a Bibliocracy rather than a theocracy. The Bible was the norm for Church and State, but the Church did not control the State, and claimed for itself absolute independence in the matter of excommunication. Calvin heightened Luther's doctrine of predestination by stressing reprobation as well as election. The Calvinists derived a terrific drive from the conviction that they constituted the elect. Calvinism gave the tone to Protestantism in France, the Netherlands and Scotland. In France Protestantism gained legal recognition by the Edict of Nantes in 1598, in the Netherlands through the victories of William of Orange in 1581, in Scotland through the life work of JOHN KNOX. Here the breach with France and the introduction of Protestantism made possible the union of Scotland with England under James I.

In England the Reformation was largely political. Henry VIII could not secure from the Pope an annulment of the marriage with Catherine of Aragon, because the Pope was controlled by Charles V, Catherine's nephew. Henry took things into his own hands, established a national Church with the king as the head, 1534, and seized church lands which he gave to his followers. Protestant doctrine, however, gained no hold until the reign of his son, Edward VI. Mary restored Roman obedience. Elizabeth adopted an ambiguous Protestantism. The Pope indiscreetly forced her into an unequivocal position by excommunication. Both sides persecuted. The mass of the people went through the changes complacently. The reform eventually endeared itself to the people in no small measure because of the superb prayer book of THOMAS CRANMER.

In Italy Protestantism never gained a hold on the masses. Perhaps heresy was played out. But the reforming movement of the mystic Valdes of Naples enlisted the sympathy of many prominent men in the Church and of a number of aristocratic women. On the reorganization of the Inquisition in 1542 some sought consolation in monastic retirement, some endured martyrdom, some went into exile. This remnant exerted an influence out of proportion to its numbers. Best known among the refugees are the Sozzini, the founders of a Unitarian movement known as Socinianism, which for a time found shelter in Transylvania and Poland.

The Scandinavian countries embraced Lutheranism. A national Church was established in Sweden. Such was the intolerance that Denmark refused a landing to Calvinist refugees from the Marian persecution.

Catholic Reformation. Reform in the Catholic Church began before the Protestant Reformation and continued along with it. The term Catholic Refor-

mation is, therefore, more accurate than Counter-Reformation, although Protestantism undoubtedly served as a stimulus. Ximenes at the end of the 15th century commenced a drastic monastic reform in Spain. The movement was entirely medieval. The rules were not to be changed, but kept. Ximenes was a fine scholar, the founder of the University of Alcalá, and director of the publication of the Complutensian Polyglot. There was at the outset no conflict between the Catholic Reformation and the new learning.

IGNATIUS LOYOLA, the founder of the Jesuits, had had a religious experience as profound as Luther's. The issue was an intensification of medieval piety, and the formation of a new monastic order, 1540, military in its organization and in its code of absolute submission. The early Jesuits reclaimed much of southern Germany for the Church.

The Council of Trent, 1545-63, formulated the doctrines of the Church. The Vulgate was declared to be the authoritative version of the Bible. The scholarship of the Renaissance was thus far repudiated.

In discussing the influence of Protestantism on the modern world a distinction must be drawn between the intentional and the accidental, as well as between the churchly type of Protestantism: Lutheran, Zwinglian, Calvinist, and Anglican, and the sectarian: Anabaptist, Socinian, Arminian, Quaker, Methodist, and others.

The contribution of churchly Protestantism to religious liberty was altogether accidental. The disruption of the unity of the medieval church, and the war of sects created an impasse from which toleration offered the only possible escape. A direct contribution came from the Anabaptists, who as a group favored religious liberty, and from the spiritual reformers such as Sebastian Franck, Sebastian Castellio and the rationalist Acontius, who drew from mysticism and humanism conclusions which had been impossible before the breakdown of the authority of the Church.

In the realm of sex and family ethics the Protestant attack on celibacy was deliberate. Marriage was regarded as a civil bond. Divorce and remarriage were thus made possible. But Protestantism as a whole, in the period of the Reformation, continued to regard marriage as a prophylactic and to encourage unrestricted propagation. The most significant development was the introduction of a spirit of experimentalism. Bigamy and polygamy were momentarily entertained, and the dissolution of marriage for religious reasons received widespread consideration and varying answers. The experimental mood passed, and the relative liberalism of contemporary Protestantism on birth control is scarcely traceable to any 16th century group.

Effects of the Reformation. In the political sphere Lutheranism defended the state from ecclesiastical interference and encouraged the state to undertake cultural tasks, but was neutral as to the form of the state and readily supported absolutism. Calvinism

recognized the right of revolution, and played a large part in the struggle against absolutism in France, Scotland and England, but pure democracy is closer to Anabaptism.

In the economic sphere Luther emphasized the divineness of civil callings, the Anabaptists adopted an ascetic attitude to the enjoyment of worldly goods, and Calvin added the drive which comes from making the chief end of man the glory of God. He also removed the ban on the taking of interest. These attitudes fostered the rise of a prosperous middle class and in some measure contributed to the development of modern capitalism.

In the scientific sphere churchly Protestantism retained the authoritarian principle and the religious censorship of books. Only a handful of liberals retained humanistic freedom. Protestantism has not directly stimulated scientific investigation, but has shown itself flexible in accommodation. Humanistic criticism of the Bible has at length been received, and theology is continually revised in the light of scientific findings.

R. H. BA.

BIBLIOGRAPHY.—*The Cambridge Modern History*, Vol. II, "The Reformation," and Bibliography, 1904; Baudrillart, *L'Eglise catholique, la Renaissance, le Protestantisme*, 6th ed., 1905; Thomas M. Lindsay, *A History of the Reformation*, Vol. I, "In Germany," 1916, Vol. II, "In the Lands Beyond Germany," 1917; Preserved Smith, *The Age of the Reformation*, American Historical Series, Bibliography, 1920.

REFORMATORIES. Early in the last century the results of the prison system showed that it was not reforming prisoners. An experiment of sentences expressed in terms of marks to be earned by prisoners through good behavior was tried successfully in an English penal colony. America's first reformatory based on this idea was opened at Elmira, N.Y., in 1876. Juvenile reformatories grew from a recognition that children should not be associated with adult inmates of prisons. The first juvenile reformatory was established in 1824 and became the House of Refuge. Reformatories have fallen short of their aim. Modern methods are showing that more individualized treatment and classification on the basis of the inmates' natures are essential to rehabilitation. See also JUVENILE DELINQUENCY.

BIBLIOGRAPHY.—Louis N. Robinson, *Penology in the United States*, 1921; John Lewis Gillin, *Criminology and Penology*, 1926; S. S. Glueck, and E. Glueck, *Five Hundred Criminal Careers*, 1930.

REFORMED CHURCH IN AMERICA (Dutch Reformed), a church founded by Dutch settlers in America and known as the Reformed Protestant Dutch Church in America until 1867. The Church was originally allied to the Reformed Church of the Netherlands founded in 1566. The first Dutch Church in America was founded in New York, then New Amsterdam, in 1628. This is still in existence as the Collegiate Church with about a dozen buildings and as many ministers. A number of French Huguenots also settled in New Amsterdam and were absorbed by the first Dutch Church. The first governor of the Dutch colony, Peter Minuit, was himself an or-

dained elder of the French Reformed Church. By 1664, 13 Dutch Churches were established among the colonies. Notwithstanding the English conquest, the Dutch churches survived, although they met with considerable opposition on the part of the established Church of England. At that time the Classis of Amsterdam still had sole ecclesiastical jurisdiction over the Dutch churches of America.

After a century or more of sectarian and factional struggle that lasted until the opening of the 19th century the Dutch Church adopted a new constitution adapted to American conditions that still rules the Church, subject to the two subsequent revisions in 1832 and 1874. By 1800 the Dutch Church had built 100 churches and within a half century had increased this number to almost 400 churches. Later decades witnessed a considerable Dutch immigration into the Middle West which resulted in the erection of 200 additional churches. The chief educational institutions of the Reformed Church in America are Rutgers College, founded in 1766; the Theological Seminary, 1784, at New Brunswick, N.J.; Hope College, 1866; and the Western Theological Seminary, 1866, at Holland, Mich. The Church has also organized successful missions in India, China, Japan and Arabia. As far as the government of the Church is concerned four officers are recognized: ministers, professors of theology, elders and deacons. The government of the Church consists of the consistory of each church; the classis of at least three churches; the particular synod representing all the churches. In 1926 the Reformed Church in America had 717 churches with a membership of 153,739.

REFORMED CHURCH IN THE UNITED STATES (German Reformed), a church founded by settlers from the Rhine provinces of Germany and from the German cantons of Switzerland. These settlements were established during the period from 1710-70 in New York, Pennsylvania, Maryland, Virginia, Carolina and Georgia. The congregations of the German Reformed Church developed most rapidly and strongly in Pennsylvania. The *coetus* was the name given to the annual conference of the German Reformed Church ministers during the period from 1725-92 when the Church was under Dutch control due to the financial assistance rendered by the Dutch Reformed Church to the German Reformed Church. This *coetus* was governed by the Holland Synod until in 1793 the German Reformed churches freed themselves from the Dutch influence and with 15,000 communicants adopted the name of the Synod of the Reformed High German Church in the United States of America. The Church founded its first theological seminary in 1825 at Carlisle, Pa. (now at Lancaster, Pa.) and founded Marshall College (now Franklin and Marshall College at Lancaster, Pa.) in 1826. The Central Theological Seminary is located at Dayton, O. In addition, a theological quarterly now known as the *Reformed Church Review* was founded in 1849. Missions have been set up in Japan and China. The *Heidelberg Catechism* contains the doctrine taught

to the youth of the Church, and in 1919 the Church accepted a *Hymnal* published jointly with the Dutch Church. The Reformed Church in the United States now stands second in size of all the Reformed and Presbyterian churches in the United States and Canada. In 1926 the Reformed Church of the United States had 1,709 churches with a total of 361,286 members.

REFRACTION, the change in direction of a ray of light when it passes from one transparent medium into another. The laws of refraction are: the refracted ray lies in the same plane as the normal and the incident ray and is on the opposite side of the normal from the incident ray; the sine of the angle of incidence divided by the sine of the angle of refraction is a constant number, called the *relative index of refraction*.

By the **WAVE THEORY** of light the index of refraction is equal to the ratio of the velocity of the wave in the first medium to its velocity in the second medium. In going from a medium, *A*, Fig. 1, to a more dense one, *B*, the angle of refraction, β , is smaller than the angle of incidence, α . Therefore, by the **WAVE THEORY**, the velocity in *B* is less than in *A*. This is found, by experiment, to be the case. Its proof was the final blow to Newton's **CORPUSCULAR THEORY** of light, according to which the velocity in *B* should have been greater.

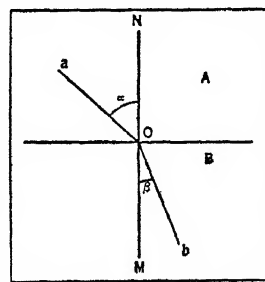


FIG. 1

In calculating the index of refraction, the medium, *A*, is usually taken as a vacuum, although, when using air, the error is negligible except when very high accuracy is desired. Its value usually lies between one and two, and is different for light of different **WAVE LENGTHS**, normally increasing as the wave length decreases. Thus, for a typical crown glass, the index increases from 1.52 for red light to 1.54 for violet.

A body in one medium viewed from a second appears to be displaced, forming a virtual image. Thus, the stick, *AB*, (Fig. 2) projecting into water appears to be of the form, *AB'*. A bundle of rays from *B* entering the eye appear to come from the point *B'*, where the rays, produced backward, seem to meet. *B'* is, then, the virtual image of *B*. Similarly, for other parts of *OB* the virtual image is *OB'*.

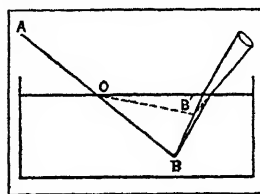


FIG. 2

If the light passes from medium *B* to *A*, (Fig. 1) and the angle β is gradually increased, the angle α increases finally to 90° . If β is increased slightly more, none of the light is refracted, but it is all reflected, following the laws of **REFLECTION**. This phenomenon is called **total internal reflection**, and is used

in many optical instruments, such as binoculars (*see* BINOCULAR INSTRUMENTS).

The index of refraction for air at the earth's surface is approximately 1.00029. At high altitudes, this index approaches unity. Light coming from the stars must pass through the earth's atmosphere, and it continually passes to regions of higher indices of refraction, in general, traveling a slightly curved path which approaches closer to the vertical. As a result of this atmospheric refraction, all objects appear to be higher than they really are above the horizon. The sun rises earlier and sets later than it would if there were no atmospheric refraction. *See also* DOUBLE REFRACTION.

P. I. W.

BIBLIOGRAPHY—R. A. Houstoun, *Treatise on Light*, 1927.

REFRACTOMETER, an instrument for measuring indices of REFRACTION, i.e., the velocity of LIGHT in a substance as compared to that in air or a vacuum. It has a number of forms. In some refractometers, use is made of the change in direction of a beam of light when it passes from one medium to another. In others, use is made of the change in WAVE-LENGTH when the light passes through the one medium, as in Michelson's or Jamin's INTERFEROMETERS. In both instruments, interference fringes (*see* INTERFERENCE OF LIGHT) are set up, and the change in the fringe pattern gives directly the change in optical path in terms of wave-length, so that the velocity can be calculated.

BIBLIOGRAPHY—R. W. Wood, *Physical Optics*.

REFRACTORY MATERIALS, materials of construction used to confine or transfer heat; also materials to resist slags, sudden temperature changes, loads under temperature, abrasion, and other destructive forces. Since no one type of refractory will withstand all conditions, a great variety of refractory products have been developed to meet given conditions. There are many types of FIRE CLAY BRICK in addition to other well-known refractories such as silica, magnesite, chromite, dolomite, bauxite, and diaspore.

REFRIGERATION, MECHANICAL, the process of securing, by mechanical means, a temperature below that of the atmosphere. As now practiced, mechanical refrigeration is accomplished by means of a volatile liquid which boils in metal "evaporators" at a low temperature, absorbing the necessary heat from the air or liquid which is to be cooled. With volatile liquids like AMMONIA, CARBON DIOXIDE and sulphur dioxide, the temperature at which boiling takes place during the absorption of heat is determined by the pressure, so that by varying the boiling pressure it is possible to secure any desired temperature of evaporation. Two distinct cycles are employed in mechanical refrigeration. These are known as the compression and the absorption processes.

The *compression* cycle, which uses ammonia, carbon dioxide, sulphur dioxide, ethyl chloride, and other volatile liquids as refrigerants, utilizes a compressor to build up the pressure of the gas from that at which boiling takes place in the evaporating coils, to the pressure in the liquefying apparatus. The refrigerant, after compression, is cooled with water in a condenser

to remove the sensible HEAT of compression. Between the condenser and the evaporating surfaces is a pressure reducing or "expansion" valve at which the liquid gasifies. Most refrigerants are harmful to life and in congested installations carbon dioxide is made use of in spite of the heavy condenser pressures required, which sometimes run to more than 1000 pounds per square inch. Sulphur dioxide is much used for household refrigeration because of the relatively low condenser pressure necessitated.

The absorption cycle makes use of heat from a flame, an electric resistance unit, or steam to drive a soluble gas out of solution, e.g., ammonia out of water. The ammonia gas, under pressure, then passes from the "generator" into a water cooled condenser, from which, in liquid form, it flows to the evaporating or refrigerating coils, passing the *expansion* valve which permits it to vaporize and absorb heat. The cycle is completed by the re-absorption of the gas in the "absorber," from which the aqueous solution is forced, by an "aqua pump," into the generator again to complete the cycle. The absorption machine is particularly advantageous in plants where exhaust steam is to be found in sufficient quantities at small cost.

The gas fired household machine, or *Electrolux*, works on an ingenious adaptation of the absorption principle. It uses a mixture of ammonia and an inert gas—such as hydrogen, which is not soluble in water. Both the "aqua pump" and the expansion valve can be dispensed with, as can all moving parts. Through the operation of Dalton's Law of Partial Pressures, the pressures throughout the evaporator and absorber can be reduced to less than 40 pounds without affecting the efficiency of the refrigerant. Because of the fact that hydrogen is not soluble in water, there is no need for an expansion valve, so the pressures throughout the system can be uniform, eliminating the need for a pump to force the "aqua" from the absorber to the generator. All the work needed for this can be supplied by a small gas flame which heats the solution coming from the absorber, making it lighter than the cool solution coming from the evaporator.

Refrigeration has made remarkable advances during the last decade. Household refrigerators have been brought into common use. A more complete knowledge of AIR CONDITIONING has developed the use of refrigeration in hotels, theaters, banks, offices and stores where a slight cooling of 5 or 10° F. below outside temperature is desirable. In some manufacturing plants, the nature of the product requires a careful control of temperature, which may be as low as 65° F. as, e.g., in some gelatine and candy factories. *See also* ICE MANUFACTURE. H. J. M.

REFUGE CHAMBER. In a mine explosion, methane burns, forming carbon monoxide, which is deadly to man. As a safety precaution some few mines are provided with chambers which may be closed off, affording a retreat from the gas. These are sometimes ventilated by compressed air pipes.

REFUSE DISPOSAL, a public health measure involving the collection and disposal of solid refuse,

garbage, generally animal and vegetable wastes, from kitchens and sometimes with other materials, as tin cans, ashes, rubbish and trash including paper, street dirt and manure. Generally garbage is kept separate from ashes and rubbish, the latter going to dumps but presenting salvage possibilities, principally of paper and metal, while the former is delivered to points where it is disposed of, usually by burying, feeding to hogs for fattening, reduction or incineration. Occasionally garbage and rubbish are combined before disposition by incineration. Burying is sometimes carried out with ash dumping. In the smaller cities and in the drier climates, hog feeding is now well organized, fresh garbage only being used, sanitary feeding platforms being employed, and manure and residue being disposed of. The hogs are inoculated against disease. Carbage is "cooked" or reduced in closed tanks, sometimes with the preliminary applications of solvents. The products are grease and "tankage," the last being generally used as a fertilizer base and sometimes in stock foods.

Garbage is sometimes incinerated or burned in specially designed furnaces, called "destructors." Such furnaces are for mixed refuse, or garbage with rubbish and sometimes with ashes. The waste heat can be used to develop steam power.

Refuse disposal often involves objectionable odors, more serious from burying or feeding and probably the least from well-operated incinerators. In the past, refuse collection and disposal services have suffered through lack of technical administration, but the growing complexity of the problem is bringing to it the necessary expert supervision based on engineering research. *See also* SANITARY ENGINEERING.

Rapidly replacing the customary garbage pail or the back yard ashcan, is the portable household incinerator, generally operated by gas. Built of cast iron or steel, in size resembling the traditional ashcan, these containers are sufficient to take care of the needs of the average family, which discards approximately 150-175 lb. of refuse per person yearly. Modern apartment houses, growing in number yearly in the U.S., have generally adopted the practice of installing central incinerator systems with an outlet convenient to each apartment for the disposal of all refuse.

BIBLIOGRAPHY.—Transactions, American Society of Civil Engineers, Vol. 92, Proceedings, American Society of Municipal Engineers, Vol. 36.

REGALIA, distinctive symbols, decorations and insignia of a particular order. Royal regalia include the emblems, symbols and paraphernalia of royalty. (*See* CROWNS.) The regalia of the Church has to do with ecclesiastical franchises, lands and hereditaments held by royal grant. Regalia occupies an important part in the ritual of many secret societies and fraternal organizations. Particularly is this true of the Masonic Order (*see* MASONRY), the oldest and most widely distributed of existing secret societies, where an elaborate system of symbolic ritual governs the meetings of the various lodges.

Each of the Masonic degrees calls for different preparation and the use of different insignia. The apron, one of the first symbols of the ancient order, carries with it, in its various uses, a deep significance. The lambskin, or white leather apron, presented to the entered apprentice in the first degree, is an emblem of innocence. The cross is closely associated with many of the Masonic degrees. Mantles, swordbelts, tunics, sashes, flags, stars, jewels and other paraphernalia are all important parts of the symbolic regalia.

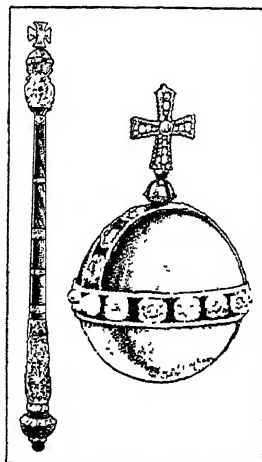
The ritual of the Independent Order of Odd Fellows, leading by degrees to the uniformed Patriarchal degree, is rich in symbolism and color. The All-seeing Eye, enveloped in a blaze of light and glory is the outstanding symbol of Odd-Fellowship. Escutcheons, banners and various decorations are widely used.

The Improved Order of Red Men, a patriotic society, based on the manners, traditions and customs of the North American Indian, incorporates in its ritual the ceremonials, nomenclature customs and dress of the Indian. One degree bears with it the wearing of the continental uniform of Revolutionary days.

Members of the Ku Klux Klan, a band of night-riders who organized to enforce order in the disrupted South after the Civil War, wore a dress of black calico called a "shroud," and a high tapering hat with a white mask over the face.

REGENCE STYLE, in architecture and the decorative arts, the style transitional between the monumental richness of the Louis XIVth period and the delicate and unrestrained lavishness of the Louis XVth period, in time covering the early years of the reign of Louis XVth, when France was governed by a regency. It indicates a strong reaction against the elaborate formalism of the Louis XIVth style; lightness, delicacy and fantastic imagination characterize it. While the style makes restrained use of the cut-off corners, shell work, and delicate naturalistic ornament that later became so common in Louis XVth work, it never reached the state of contorted over-elaboration that sometimes characterizes the later style.

REGENERATION. When a wound heals the injured tissues regenerate. When a lizard's tail, a salamander's leg, or a star-fish's arm, is broken off, the lost part is restored by the growth of another in its place. The simpler, less differentiated, the organism, the greater is its power of regeneration. This is because its substance, tissues and cells, retains the unspecialized nature and powers of growth of egg and embryo. When specialization is attained, fur-



SCEPTER AND ORB OF THE KING OF ENGLAND

ther growth is restricted. The kinetic energy is directed into other channels.

With regeneration in simple organisms goes regulation, that plasticity by which an organ may be reshaped in conformity with the structure of the rest of the organism; thus one of the tentacles in a hydra deprived of its trunk, or tubular body, may itself be transformed gradually into another trunk.

Grafting is an important application of regeneration, whether in surgery or in horticulture. The student of embryology, by transplanting bits of one embryo into various parts of another, learns of the influence of one part upon the rest. Such experiments on the embryos of frogs and salamanders show that there are special regions called organizers which determine the manner of development of the unspecialized cells around them, e.g., the nerve cord and other organs of the back. Such an organizer, planted into the surface of another embryo, produces a secondary mate growing upon its side. J. H. G.

REGENERATION, in radio, feeding of energy from the plate circuit to the grid circuit of an electronic tube (*see* TUBES, ELECTRONIC). The amount of power transferred is ordinarily kept below the value necessary for self-sustained oscillations (*see* OSCILLATOR, ELECTRIC). The transfer of power then simply results in a building up of the signal currents supplied to the tube. The principle is frequently employed in DETECTORS to increase their sensitivity many hundred-fold.

REGENERATIVE CYCLE, a steam-power generating cycle in which the BOILER feed water is heated in steps by steam whose expansion to the exhaust pressure of the main turbine (*see* TURBINE, STEAM) or engine has not been completed. In the common arrangement, the main steam turbine is tapped at from one to four points between the throttle and the CONDENSER. From these points, steam is carried to pipe-coil heaters, through which condensate from the main condenser is pumped in series on its way back to the boiler. Steam passes first to the low pressure heaters and then to those supplied with steam at high pressures. Since the temperature of saturated steam increases with the pressure, the water is heated in "steps." This arrangement, almost universally used in modern steam power plants, saves fuel by salvaging power from the steam before it is used to heat feed water. P. W. S.

BIBLIOGRAPHY.—W. N. Barnard, F. O. Ellenwood and C. F. Hirshfeld, *Heat-Power Engineering*, 1926.

REGENERATIVE FURNACE, a metallurgical furnace in which the draft is pre-heated by the waste heat of the flue gases. To accomplish this a RECUPERATOR is employed. The regenerative system effects considerable fuel saving since a large portion of the heat generated in a metallurgical furnace (*see* FURNACES, METALLURGICAL) passes out with the flue gases.

REGENSBURG. *See* RATISBON.

REGENT'S PARK, a handsome park of 427 acres in Marylebone, London, England, famous as the

home of the Zoological Society of London (the "Zoo"), the Aquarium and the Botanic Gardens. The present grounds—originally Marylebone Park—were laid out by John Nash in 1812, and were named after the Regent, later George IV. Enclosing the park is a driveway, the Outer Circle; the Inner Circle encloses the Botanic Gardens, founded in 1839, covering 18 acres. The Broad Walk, an avenue of chestnut trees flanked by flower beds, should be noted, as should also the Regent's Canal. Bedford College for Women, founded in 1849, and the Royal Chapel of St. Katherine, 1829, are in the park. But most important are the Zoo, established 1826 and covering 35 acres, and the Aquarium, opened in 1924.

REGENT STREET, one of the principal thoroughfares in the West End, extending from Portland Place to Waterloo Place, London. It was laid out in 1813, is about a mile and a half long, and contains some of the best shops in the city.

REGER, MAX (1873-1916), German music composer, was born at Brand, Bavaria, Mar. 19, 1873. A student at the Sondershausen and Wiesbaden conservatories, he taught at the latter school and at the Munich and Leipzig conservatories. In 1907 he was appointed musical director of the University of Leipzig. His compositions include four orchestral tone-poems, two sets of variations on themes of Hiller and Mozart, five string quartets and other chamber music, including nine violin sonatas; 38 motets and other choruses, and a number of organ works. Many of his compositions are marked by extreme contrapuntal dexterity. He died at Leipzig, May 11, 1916.

REGGIO DI CALABRIA, also Reggio Calabria, capital city of the Italian province of the same name, in Calabria, southwestern Italy, in 38° 8' N. lat., 15° 40' E. long., situated on the Straits of Messina and the railroad to Naples. The city and harbor were almost entirely destroyed by earthquake on Dec. 28, 1908, and more than 20,000 people killed; earthquakes also occurred in 1783, 1811 and 1894. It is seat of a bishop. The Roman *Regium*, it was captured by Alaric in 410, by Totila in 549 and in 1060 was taken by Robert Guiscard. Pop. 1931, 122,728.

REGGIO NELL'EMILIA or **REGGIO EMILIA**, the capital of the province of the same name, in Emilia, north central Italy, on the Crostolo River. It is situated in a fertile plain and served by several railroads. The wide streets are lined by arcades and the old city ramparts have been made into promenades. The 12th century cathedral was restored, 1544, and the 10th century basilica, San Prospero, in 1504. Noteworthy also are the baroque Church of the Madonna della Ghiera, 1597-1619; the city hall, 1414; the former Benedictine Monastery, 16th century, with two cloisters; the theater and park. The seat of a prefect and of a bishop, it has advanced schools, a royal cattle-breeding and cheese-making school, a library, museum and hospitals. It is the center of an agricultural area, and is celebrated for its grape culture. The town has a brisk trade in sausages and cheese; locomotives and matches are in-

cluded among the industries. As the Roman town, Regium Lepidi, it was the center of a Frankish county. It fell to the House of Canossa in the 10th century, in 1290 to the Este house, and was united to Sardinia in 1859. Reggio nell' Emilia was the birthplace of ARIOSTO. Pop. 1931, 91,040.

REGILLUS, a lake of ancient Latium located at the foot of the Tuscan hills. It is famous in history for the battle between the Romans and the Latins that was fought there in 496 B.C. under the command of Mamilius. Poets have so immortalized the struggle that its actual historical significance is somewhat difficult to determine. Most celebrated among such poems is Macaulay's well-known *Horatius at the Bridge*.

REGINA, the capital city of Saskatchewan, Canada, situated at an altitude of 1,885 ft., on the Canadian National, Canadian Pacific, and 12 branch railways, 357 mi. west of Winnipeg. Centrally located in an agricultural region of which it is the market and distributing point for farm machinery, Regina also has many industries, including large oil refineries, mills, dairies, breweries, packing plants and automobile manufactories. It is an aviation center. A well-built city, Regina has the imposing provincial government buildings and grounds covering 180 acres, and many schools, colleges, parks and public works, including its own light and power plants, waterworks and street railway system. Regina was founded in 1885 to provide the government with a prairie city headquarters and remained until 1905 the capital of the old North-West Territories of Canada. Incorporated in 1903, Regina became the provincial capital in 1905. Pop. 1921, 34,432; 1926, 37,329; 1931, 53,209.

REGIONAL PLANNING. See TOWN AND CITY PLANNING.

REGISTERED STOCK, stock registered on the books of the issuing corporation as belonging to an individual and bearing on the face of the certificate the name of the person or concern to whom it was issued. Nominally it cannot be transferred without placing the signature of the owner upon the books of the issuing corporation and delivery of the certificate. American share securities are almost invariably of the registered type. In England they are transferred by deed. In the United States the owner may assign the certificate by endorsing on its back. When this certificate has been signed by a STOCK EXCHANGE firm it can be delivered in the market almost as if it were in bearer form. Actual transfer need not occur at once and often does not until forthcoming dividends make it necessary for the actual owner to register his ownership in order to avoid complications in the receipt of dividends. Between dividend periods registered certificates circulate in the market still made out in the name of the original owner and endorsed by the subsequent possessors. Such certificates are known as street certificates. Thus United States registered stock is almost as readily negotiable as bearer shares, so much preferred in many parts of Europe.

REGNARD, JEAN FRANÇOIS (1655-1709), French dramatist, was born at Paris, Feb. 7, 1655. In his semi-autobiographical novel, *La Provençale*, he relates how he was captured by Barbary pirates, carried to Algiers, and bought by a Turk, who took him to Constantinople. Ransomed by his family, he traveled widely. His plays, written in a simple natural style, *Le Divorce*, 1688, *La Coquette*, 1691, and *La jone de Saint-Germain*, were praised by Voltaire, while other critics ranked him next to Molière in the field of comedy. He died at the Château de Grillon, Sept. 4, 1709.

RÉGNIER, HENRI FRANÇOIS JOSEPH DE (1864-), French poet and novelist, was born at Honfleur, Dec. 28, 1864. After contributing articles to French periodicals, he turned to poetry, *Les Lendemain* appearing in 1885. Five years later his most popular collection, *Les Médailles d'Argile*, was published. Régnier is also the author of several realistic novels, among which are *La Canne de Jaspe* and *L'Escapade*.

RÉGNIER, MATHURIN (1573-1613), French satirist, was born at Chartres, Dec. 21, 1573. He entered into religious orders at an early age, and spent a considerable part of his life in the service of Cardinal François de Joyeuse. Not until about 1605 did Régnier settle down and devote himself to writing. He was made a canon of Chartres in 1609. His satires, natural and elegant in style, are founded on classical authors, but in his lesser poems he shows himself as gentle and delicate as PIERRE DE RONSARD. Régnier died at Rouen, Oct. 22, 1613.

REGULATION, NORTH CAROLINA, 1765-71, a popular uprising against corruption and extortionate taxes in the western counties of North Carolina. The provincial government was intensely bureaucratic; the governor, who held the bulk of the appointive power, was independent of popular influence. County and parish taxes were levied by the county court and collected by the sheriff, neither being responsible to the people. Officers were paid by the fee system, and took full advantage of that system's abuses. An aggravating circumstance was the financial distress then visiting the province. Minor disturbances in 1765 were suppressed easily. In 1766 delegates from the settlements of Orange County demanded an annual meeting wherein the people might investigate the conduct of the civil officials; Col. Edmund Fanning, leader of the "court party," branded the proposal as insurrectionary. Agitators attempted to prosecute culpable officials, but could find no lawyer honest and willing to take the cases. In the spring of 1768 the sheriff posted notice that taxes were to be paid at certain specified places, and a distress levied upon all delinquents. Resistance was immediately organized, taking the name Mob but shortly discarding that for Regulation. Manifestoes were issued and agreements signed to "pay no more taxes until we are satisfied that they are agreeable to law, and applied to the purpose therein mentioned, unless we cannot help it, or are forced." Fanning's house was fired upon;

the county militia was ordered out, and two leading Regulators, William Butler and Hermon Husband, were arrested on the charge of inciting to rebellion. A mob of 700 forced the release of the prisoners. Gov. Tryon warned the Regulators against treason, ordered them to desist resistance to the tax-collecting, and promised to prosecute delinquent officials. The prosecutions, however, were farcical, Fanning, convicted of malfeasance, was fined five pennies on five counts. When the Regulators, having waited vainly for redresses, again became active, Gov. Tryon raised an army of militia which met and dispersed the rebels at the Battle of Alamance. Thereafter the Regulators submitted. By July 1771, 6,409 persons had taken an oath of allegiance required by Tryon, and in the next year the outlawed leaders surrendered themselves. Ultimately, at the order of the Crown, all except Husband were pardoned.

REGULUS (*Alpha Leonis*), a star of the first magnitude and the brightest star of the constellation Leo. It is a bluish-white star 70 times brighter than the sun, accompanied by a yellow star 2 or 3 times fainter than the sun, and at a distance of 57 light years. Its name means "little king." See **STAR: map**.

REHAN, ADA (1860-1916), American actress whose family name was Crehan, was born at Limerick, Ireland, Apr. 22, 1860. She came to America at five, and made her first theatrical appearance in 1874. After playing in Philadelphia, Albany and Baltimore, she joined **AUGUSTIN DALY** in 1879, and in his repertory company visited Europe in 1884 and 1886. Her charm, vivacity and dramatic intelligence made her highly successful as Katherine in *The Taming of the Shrew*, Peggy in *Wycherly's Country Girl*, Sylvia in *Farquhar's Recruiting Officer*, Viola in *Twelfth Night* and Countess Vera in *The Last Word*. She died at New York City, Jan. 8, 1916.

REICHENBACH, a German city in Saxony about 10 mi. southwest of Zwickau. It was mentioned as a city in the early 12th century. The city is primarily devoted to the textile industry, but it has other factories as well. It trades in grain, yarn and lumber. Pop. 1925, 30,841.

REICHENBERG. See **LIBEREC**.

REICHSBANK, the CENTRAL BANK of Germany, was created in 1874 from the old state Bank of Prussia. Until the World War, the Reichsbank was the principal holder of the gold stock of the country, and was required to hold a reserve of MONEY and BULLION to one-third of the amount of its notes, the rest covered three-months bills. There was also a limit to the amount of notes it might issue. The Reichsbank was the principal lender to the money market at the end of each month when stock settlements were made, at the quarterly settlement days, and at other times of stringency.

The law of 1924 widened its functions. It played an important rôle in the STABILIZATION of the mark and in the return to the gold standard. As reserve against its notes it must now hold a 40% reserve in either gold or FOREIGN EXCHANGE. Since stabilization,

the Reichsbank has been building up its gold holdings, and has been taking more aggressive action in the MONEY MARKET than it did formerly. It has frequently initiated important changes in the BANK RATE, and it has utilized its open-market operations to control the money market. In respect to open-market powers, the Reichsbank resembles the Bank of England rather than the Bank of France, for it deals in Treasury bills of three months duration or less, and it may also lend against certain types of securities. In addition to these customary forms of credit control, the Reichsbank has on occasion announced that it would refuse to loan to banks which did not pursue a policy of contraction—a type of direct action which has not been attempted, at least openly, by any other central bank. The Reichsbank has 17 main offices in leading cities of Germany, and 428 branches and agencies. One of its most important activities is that of acting as the CLEARING HOUSE for Germany. See also REDISCOUNTING. B. H. B.

REICHSMARK, the German paper MARK, introduced by the Reichsbank in Nov. 1924, with the post-war reconstruction of the German currency. It is equivalent to 238 cents at par. The Reichsmark was introduced as the equivalent of 1,000,000,000,000 old paper marks and equal to the Rentenmark, a temporary domestic currency introduced in Nov. 1923 and which it replaced.

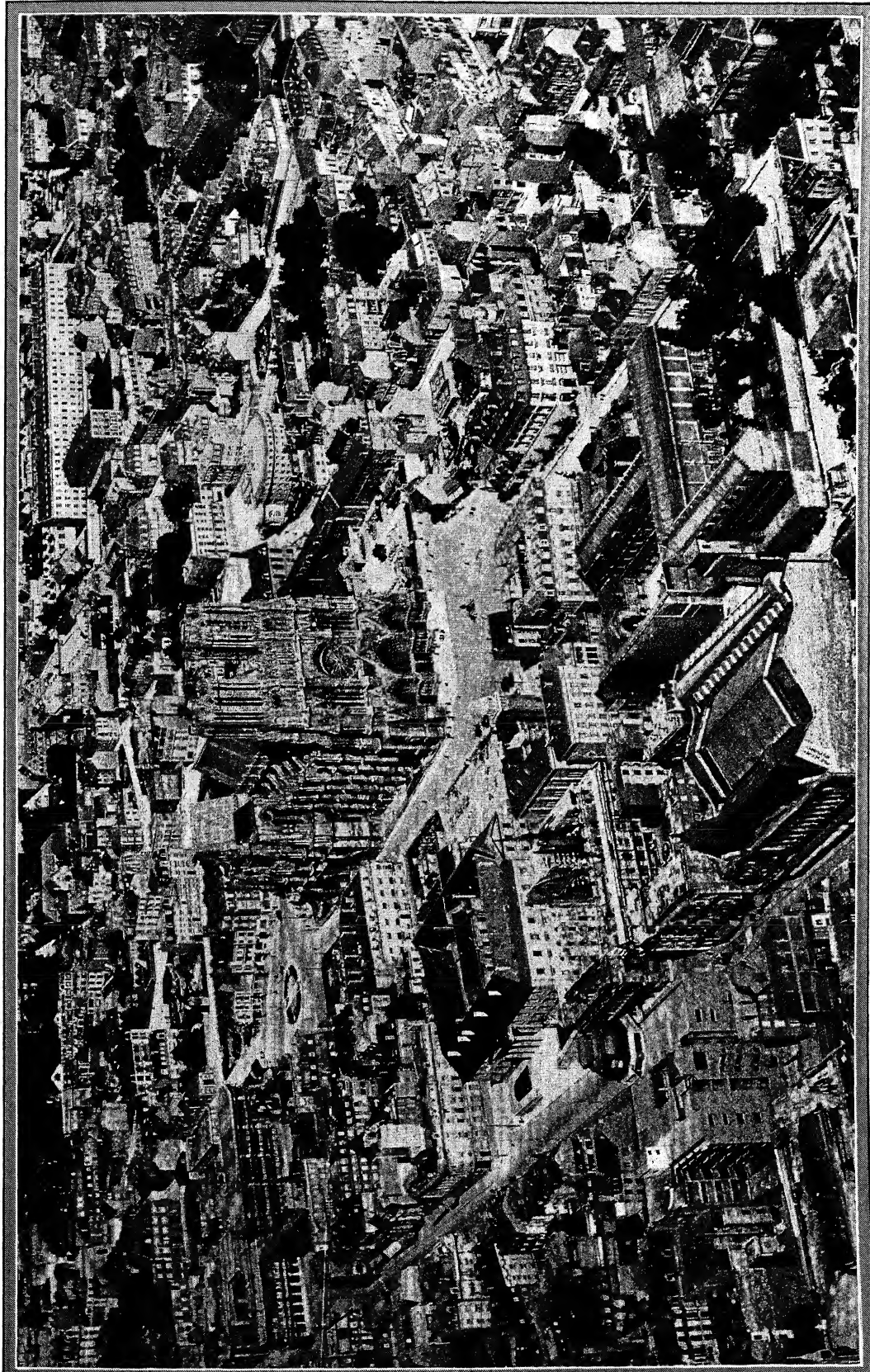
REICHSTAG. See **RIGHT PARTIES**.

REID, WHITE LAW (1837-1912), American diplomat and editor, was born at Xenia, O., Oct. 27, 1837. His career in journalism began in 1858, and he first commanded attention by his Civil War dispatches for the *Cincinnati Gazette*. In 1863-66 he was librarian of the House of Representatives, and in 1868 joined the *New York Tribune*, becoming proprietor and editor-in-chief in 1872. His control of this important paper made Reid an influential figure, locally and nationally. In 1892 he was the vice-presidential nominee of the Republican Party and was defeated with Benjamin Harrison. In 1898 he was appointed member of the American-Spanish Peace Commission which met at Paris. He was Minister to France in 1889-92, during which period he concluded several important reciprocity treaties, and in 1905-12 was ambassador to Great Britain. His chief literary works were *After the War* and *Problems of Expansions*. He died at London, Dec. 15, 1912.

REIDSVILLE, a town in Rockingham Co., in the northern part of North Carolina. It is situated in a famous tobacco-growing region, 75 mi. northeast of Raleigh, and is served by the Southern Railroad. The town has several tobacco factories and tobacco warehouses, as well as cotton mills and other industries. It was first settled in 1860 and incorporated in 1873. Pop. 1920, 5,333; 1930, 6,851.

REIGN OF TERROR, also called The Terror, generally refers to the period of control by MAXIMILIAN ROBESPIERRE during the FRENCH REVOLUTION, July 10, 1793 to July 28, 1794 (10th Thermidor). The Revolutionary Tribunal of Paris, the body before

REIMS



ORIENT AND OCCIDENT PHOTO

AERIAL VIEW OF REIMS AND THE CATHEDRAL OF NOTRE DAME

"The most beautiful structure produced in the Middle Ages," the Cathedral of Reims is an outstanding example of early 13th century Gothic architecture. The photograph shows the restoration over the north transept and the still-demolished roof at the crossing of the transept and nave.

which the condemned received what passed for a trial, had been set up on Apr. 6 and had already been at work before Robespierre's power became dominant in the Committee of Public Safety; but the descent of the Terror into mere butchery came later. During this period the Convention sank to a mere creature of the Committee of Public Safety, a body for whose control three Jacobin factions engaged in bitter struggle. On the one hand there was Robespierre backed by Couthon and the doctrinaire Saint-Just; secondly the followers of Hébert, composed substantially of the riff-raff and collected cut-throats of Paris, and in the third place the followers of Danton who sought rather to obtain a strong government than to carry out ideals and therefore drifted towards moderation.

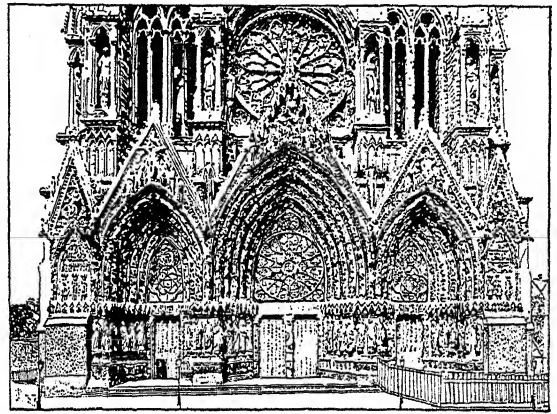
The national situation during the spring and summer of 1793 grew so desperate that to some extent popular feeling was willing to support extremist measures as a remedy of desperation. The Vendée, Lyons and Marseilles were in revolt, enemy armies were over the frontiers, and the surrender of Toulon so shocked Paris as to enable Robespierre to dominate the Moderates and in September by adding Collot d'Herbois and Billaud-Varenne, followers of Hébert, to the Committee, to inaugurate a policy of savage and wholesale executions. The Queen was executed in October, the Girondists soon followed, and in April Robespierre's power was great enough to send even Danton to the guillotine. In all some 3,000 persons were executed in Paris and probably over 17,000 throughout France. The fall of the Terror came from its own excesses, basically in disgusting public opinion, and specifically by the law of 22nd Prairial (June 10) which deprived members of the Convention of the immunity from arrest which they had formerly enjoyed. This forced them, for the mere need of keeping their heads, to stand up against Robespierre and his followers. In July opposition to Robespierre gradually developed, taking the form of a conspiracy of Moderates and Jacobins. On July 27 (9th Thermidor) they attacked him in the Convention and outlawed him. For a few hours it looked as if the Commune would take up his cause; but through his own indecision and the vigorous action of the Convention he was rearrested and sent to the Guillotine with 21 others of his party on July 28 (10th Thermidor). Public opinion was thoroughly behind the Convention and a policy of moderation followed.

But the members of the Committee of Public Safety were not all terrorists. On it were men like Carnot (War Department) whose sole interest was the recreation of government in a land which had sunk very nearly into anarchy, and in this they so brilliantly succeeded that France came out of the Terror though with no help from the terrorists themselves, with a government, an army, a tax system and independence from foreign military power where she had entered it with none of these. L. Br.

REIMS (Rheims), a city in northeastern France, especially famous for its Gothic cathedral. The Ger-

man bombardment of Reims began in Sept. 1914, and continued throughout the war, practically destroying the town and doing irreparable damage to the cathedral. Reims has important woolen and other industries, and is the center of the champagne trade. It is the capital of the department of the Marne. Pop. 1931, 112,820.

The Cathedral of Notre Dame at Reims was the great national and royal cathedral of France during the entire medieval era. Here, on Christmas Day, 496, Clovis was baptized as a Christian, and in memory of this ceremony the kings of France made Reims the place of their coronation. In this cathedral on July 17, 1429, Jeanne d'Arc crowned Charles VII King of France. A basilica of Reims, built in the



WEST PORTALS OF THE CATHEDRAL OF REIMS
13th century Gothic architecture

9th, 10th and 12th centuries, was destroyed by fire on May 6, 1210, and exactly one year later the erection of the present cathedral was begun. The choir was finished in 1241, and the edifice was practically completed by 1290. The splendid west façade, which Ferguson calls "perhaps the most beautiful structure produced in the Middle Ages," dates from the late 13th century. The towers were completed about 1480. Spires were planned; but the funds set aside for them were exhausted in repairing the cathedral after a fire in 1481, and the spires were never built.

Reims, like that celebrated group which includes Chartres, Bourges, Amiens and Notre Dame of Paris, was notable for its purity of proportion and its richness of ornament. The uncommonly durable stone of which it was built had nobly withstood the wear of centuries, up to 1914; and even after the heart-breaking bombardment and conflagration of the World War the main body of the church remained standing, although its beautiful details of sculpture, glass and decoration, together with the fine vaulted roof, were in most part destroyed except for some of the carved work in the interior. Restoration was begun soon after the end of the war.

REINDEER (*Rangifer tarandus*), a European and Asiatic member of the deer family, closely related to the North American caribou. Both sexes have antlers. The general color is gray-brown, lighter on the neck

and belly. The muzzle is hairy, ears and tail short and the neck maned on the underside. Reindeer have long been domesticated in northern Europe and Asia, but the North American caribou have apparently never been so utilized. The reindeer makes possible the existence of inhabitants of Lapland and northern Siberia. It furnishes skins for tents, flesh and milk for food, and has great endurance and speed as a draught animal. Wild reindeer are still found from northern Scandinavia to eastern Siberia. They wander through the tundra and over treeless mountains, periodically migrating from one feeding ground to another. They are browsing animals, scraping away snow to reach lichens which are their chief winter food.

Late in the 19th century, because of the white man's slaughter of walrus and whales, the Eskimos of the north Alaskan coast were threatened with starvation. To establish a new food supply, the United States government in 1889 imported a small herd of Siberian reindeer, with a party of Laplanders to teach the Alaskans how to give the animals proper care. Thus started one of the most successful experiments ever made in animal industry. By 1903 the 550 reindeer imported had increased to 5,000, the Eskimo tribesmen readily learning to care for them. In 1914 there were 62 herds and 47,266 reindeer, and in 1930 the number had increased to 600,000, largely belonging to Eskimos. As the best coast ranges are stocked to capacity, it is planned to move some coastal tribes and their herds to vast untouched ranges inland. Thousands of carcasses are sent each year to be sold as reindeer meat in the United States. A. R. F.

REINDEER LAKE, an irregularly shaped body of water in the northeastern part of Saskatchewan Province, Canada. Its length varies from 150 to 200 mi. with a mean width of 25 mi. The waters are remarkably clear and deep and numerous islands are scattered over the surface. A winding strait brings into it the waters of Lake Wollaston to the north, and the Reindeer River drains it southward into the Churchill River.

REINDEER MOSS (*Cladonia rangiferina*), a lichen covering large areas in arctic regions, reaching northward almost to the extreme limits of vegetation, and abundant also in the north temperate zone. It consists of a gray, cylindric, much-branched thallus, 2 in. or more high, containing a large amount of the nutritive starch called lichenin. In high northern latitudes the plant forms almost the sole winter food of the reindeer. When powdered and mixed with flour it is sometimes eaten by man in times of scarcity.



REINFORCING BARS FOR CONCRETE

REINFORCING BARS in reinforced concrete construction are mostly in the form of rods of round or square cross-section. They vary in size from $\frac{1}{4}$ inch to $\frac{3}{8}$ inch for light floor slabs up to $1\frac{1}{4}$ inches as

a maximum size for heavy beams and columns. Both plain and deformed bars are used. With plain bars the adhesion between steel and concrete is depended upon to furnish the necessary bonding strength. With deformed bars, the adhesion is supplemented by a mechanical bond due to the shape of the bar.

REINHARDT, AURELIA HENRY (1877-), American educator, was born at San Francisco, Cal., Apr. 1, 1877. She was educated at the University of California and at Yale. She taught English at the University of Idaho, 1898-1901, and then at the State Normal School, Lewiston, Idaho, retiring in 1909 upon her marriage to Dr. George Frederick Reinhardt. She returned to teaching after her husband's death in 1914, lectured in English at the University of California, and in 1916 was made president of Mills College. Mrs. Reinhardt was president of the American Association of University Women, 1923-27, following which she was chairman of the Association's committee on international relations. She has published a number of critical and historic literary studies and translations.

REINHARDT, MAX (1873-), Austrian producer and scenic designer, was born at Baden, near Vienna, Sept. 9, 1873. He made his dramatic debut at the age of 20 at Salzburg, and the following year joined the company of the Berlin Deutsches Theater. In 1902 he was appointed its director. In this post Reinhardt undertook the production of Goethe's *Faust*, *Oedipus Rex*, *Erdegeist* by Wedekind, G. B. Shaw's *Caesar and Cleopatra*, and Oscar Wilde's *Salomé*. His novel methods won him a reputation as the foremost producer and scenic designer of Europe. He directed the New York production of *The Miracle* in 1922, and again visited the United States in 1927-28. In 1924 he became director of the Theater in der Josefstadt, Vienna, and in summers undertook the production of the celebrated performances of the *Festspiele* at Salzburg. In 1931 he produced at Berlin the *Tales of Hoffmann* of Offenbach with modern settings, and in the same year produced *La Belle Hélène*, by the same composer, at Covent Garden, London, against a modernistic background.

RE-INSURANCE TREATY, a treaty between the German Empire and Russia negotiated by Bismarck and Shuvalov in 1887, by which the two Powers agreed that if either should find itself at war with a third Power the other would maintain a benevolent neutrality excepting in the case of an attack upon Austria or France by one of the contracting parties. Germany recognized the rights historically acquired by Russia in the Balkans, and both Powers agreed to support the *status quo* and to oppose any change in the Near East without previous agreement. They recognized the binding character of the principle of the Straits as based on international agreements. A protocol signed on the same day, June 18, provided for the reestablishment of a regular government in Bulgaria.

The treaty expired in 1890, and both Bismarck and

the Tsar expected its renewal, the Tsar instructing his representative of Berlin to begin negotiations toward that end in Dec. 1889. But in Mar. 1890, Bismarck was dismissed, and Emperor William II, advised by the Foreign office, refused to renew the treaty. This radical departure from Bismarck's policy not only deprived Germany of the protection on her eastern border in case of war but left Russia free to take up with France the negotiations which led to the formation of the Franco-Russian alliance.

REJUVENATION. The quickening of vital activity of organisms in the spring or the awakening after a refreshing sleep, are times of rejuvenescence. Chemical action within the body, known as metabolism, is then active; respiration is vigorous; wastes are quickly eliminated. But, strictly, the term applies to revival during old age, such as may to a certain extent be brought about in some animals by change of food or elimination of waste products.

The enthusiastic hopes of Dr. Voronoff that grafting the testes of young primates into old men or of young bucks into old rams would restore their youth have not been shared by eminent physiologists best acquainted with these experiments.

Biologists have been interested in the apparent rejuvenescence in unicellular organisms by conjugation, or union in pairs, when an exchange of nuclear material occurs. Such union in lower algae is often followed by a stage of quiescent hibernation, but in *PARAMECIUM* a temporary union precedes a series of vigorous cell divisions during which the mature ex-conjugants break up into half-size, youthful daughter cells, the only type of reproduction of which these organisms are capable. Weismann long ago claimed potential immortality for Protozoa, since they divide and become young whenever they reach maturity. Modern studies support this idea. J. H. G.

RELAPSING FEVER, a febrile disease caused by infection with a spirochaete resembling that of syphilis and characterized by a fever lasting about a week, followed by a single relapse of similar duration after the interval of another week. The disease is carried by lice which have been infected by having fed on patients having the disease. After an incubation period of one week, the disease begins rapidly with a chill, bone pains, and dizziness. The temperature rapidly rises to 103° F., but the fever breaks after from five to eight days. The recurring attack resembles the first but is usually milder. Salvarsan and other arsenicals can be quite effectively used against the disease, as against syphilis. However, mortality is low, even without such treatment.

There are several closely allied affections, of which African tick fever is one. The fevers are of shorter duration, but the number of relapses is greater.

RELATIVITY. According to the hypothesis of relativity, two trained observers who are moving with respect to each other with any uniform velocity whatsoever, will deduce the same physical laws for a phenomenon of nature. For this to be true it is necessary that one adjust his ideas of the methods by which

measurements are made. Since practically all physical laws may be expressed as combinations of length, mass and time measurements, EINSTEIN examined the meaning of these three fundamentals very closely. By including, also, the short time required for the light to travel from the observed object to the observer, he was led to radically new conceptions of the geometry of space and time.

The relativity theory does not alter the usual physical laws, except when dealing with events occurring on bodies moving past the observer with extremely high velocities, e.g., 10,000 mi. per sec. The higher the velocity, the greater the modification. The modified laws hold true regardless of the frame of reference from which they are tested.

Two clocks which run in synchronism will not do so if the velocity of the systems are altered in any way. In other words, the size of the time unit and the number of "seconds" counted depend on the velocity of the moving body. Observations of length and of mass, as well as of time, made by a fixed observer of occurrences in a moving system, will not be the same as those obtained if he were on the moving system. The happenings will remain the same, but the number of units of length, mass or time involved will alter; i.e., the count will change, but the physical laws will remain intact. The size of the unit of length will become larger, so that the body will appear shorter; the seconds of the time will be longer, so that time will seem to pass more slowly; and the mass of the moving body will be greater than to an observer on the moving body. These changes are expressed mathematically by the Lorentz transformation equations:

$$t' = \beta \left(t - \frac{\mu x}{c^2} \right), x' = \beta (x - \mu t), y' = y, z' = z,$$

$$\beta = \frac{1}{\sqrt{1 - \frac{\mu^2}{c^2}}}, m = \beta m_0$$

where μ is the velocity of the system moving uniformly in the x direction; c is the velocity of light in free space; x, y, z are distances along three mutually perpendicular axes as measured by an observer moving with the occurrence; x', y', z' are distances as measured by an observer whose relative velocity in respect to the occurrence is μ ; t, t' are time as measured with the occurrence and on the moving system, respectively; m_0 is the mass of a body at rest and m is its mass when moving with a velocity μ . J. B. H.

In Astronomy, relativity enters chiefly through three effects observable in the solar system, which three effects constituted the only possibilities of experimental verification when the theory was first announced. In the first of these, relativity demands that the orientation of the elliptic orbit of Mercury be changing in space at a faster rate than was indicated by Newtonian mechanics. Since the orientation of an elliptic orbit is usually designated by the direction of the perihelion, as seen from the sun, the relativistic

effect manifests itself as a steady change in the direction of perihelion and for this reason is called the advance of the perihelion of Mercury. The effect had been observed and had long puzzled astronomers; it was immediately explained by relativity.

The second effect, often called Einstein-effect, is the bending of light rays in the neighborhood of massive bodies. According to the relativistic conception light has mass, and is therefore attracted by any other mass. It is best observable during a total eclipse of the sun, when the light rays from distant stars may be seen quite close to the sun's limb. The deflection demanded by relativity was first indicated by the observations of 1919, and conclusively proved at the eclipse of 1922.

A third effect likewise finds its cause in the mass of light rays; the light emitted by the sun itself is attracted back toward the sun, and its vibrations are slowed down so to speak, making the color redder. The observable amount of reddening in the sun is exceedingly minute, but accurate observations have again substantiated the relativistic prediction. This same effect, the "red-shift," may reach far greater proportions in white dwarfs which are of such enormous density that the slowing down force on their surface is vastly greater than that in ordinary stars. In the one case where observations could be made, viz. on the faint companion star of Sirius, the predicted reddening has been found.

From the theory of relativity with its subsequent extensions certain deductions may be made concerning the finiteness of the universe, and the possibility that distant objects in the universe may appear to be receding from us at great speeds. But neither theory nor observation is far enough advanced to admit of any definite conclusions.

W. J. L.

RELATIVITY: PHILOSOPHICAL ASPECTS.

It is customary to regard nature as a collection of material objects and living organisms located in a limitless invisible container called space and an endless unique series termed time. Reflection suffices to make this questionable. We do not see nature *in* space and *in* time. The material content of the observed world is not one thing, and time or space another. Yet science and common sense have so regarded them. How did such a conception arise? The answer appears in Greek science. In order to account for matter and change, it found that nature must be made of moving atoms and that motion is impossible without something other than the kinetic particles. It was to provide this additional something in order to make motion intelligible that the spatial characteristics of nature were separated from its material content and turned into an independent entity called absolute space. Moreover, when Galileo's investigations revealed the importance of time it also was separated from the material content and made an absolute. With Young and Fresnel the same procedure was applied to the medium for light propagation. Thus science and common sense came to conceive of nature as a collection of objects located in

absolute time and moving in an infinitely extended container called space.

Special Theory of Relativity. Finally, this artificial top-heavy structure fell of its own weight in the birth of two startling new theories. The first came in 1905 when the absolute ether, absolute time and absolute space collapsed, and is known as the special theory of relativity. The second came in 1916 when absolute gravitation and absolute space-time gave way, and is known as the general theory of relativity. With our most elementary conceptions ruined in this fashion how are we to conceive of nature? Three answers have been given. Eddington and Jeans, impressed by the mathematical emphasis of Einstein's work, conclude that nature must be regarded as a system of mathematical forms. This, as Jeans has recognized, is a return to the Platonic philosophy which dominated science in the Greek period and civilization in the Middle Ages.

An analysis of the special theory reveals that this is a most questionable position. It rests upon Einstein's definition of what we mean when we say that two events far apart happen at the same time. His answer is that two such spatially separated events are simultaneous when light rays leaving both upon their occurrence arrive at a point equi-distant from both at the same time. In short, the simultaneity of spatially separated events, which is not given immediately, is defined in terms of the immediately given simultaneity of coexistent events and motion in the form of light propagation. The last phrase is important. It indicates unequivocally that the theory of relativity is a physical theory and that it entails a physical philosophy which can provide a meaning for motion.

Motion Demands a Referent. But now that space is rejected by the special theory, and space-time by the general theory, what can be meant by motion? It is impossible without a referent. The theory of relativity as it comes from Einstein gives no answer to this question. In correcting the error of the Greeks and Newton, which consisted in turning the spatial and temporal structure of nature into containers for nature's physical content, contemporary physics leaves unsolved the problem of motion which gave rise to that error. Only two ways out of this difficulty are possible. Either the conception of nature as a physical system and the theory of relativity as Einstein formulated it must be rejected, or a new referent for motion must be provided to replace the discarded absolute space. Whitehead takes the former alternative. The result is a functional philosophy of a modernized Aristotelian type in which nature is conceived as a single process containing abstracted parts called events which classify into simultaneous groups in different ways, thereby giving rise to alternative time-systems, each of which contains a constant spatial structure which provides a referent for motion. The writer of this article pursues the latter alternative introducing a physical substance termed the macroscopic atom and retaining the special and

general theories as Einstein has formulated them. We are perhaps too close to these stupendous alterations in our most commonplace conceptions to be able to see the issue as a whole and choose decisively between the proposed theories. But through all the differences one thing remains certain. Space and time are relations between the parts of nature rather than containers for its content. F. S. C. N.

BIBLIOGRAPHY—A. Einstein and H. Minkowski, *The Principle of Relativity*, A. S. Eddington, *Space, Time and Gravitation*, A. N. Whitehead, *The Concept of Nature and The Principle of Relativity*, F. S. C. Northrop, *Science and First Principles*.

RELAY RACES, competitions in running by two or more groups of equal numbers. The groups are usually composed of four in each set, one from each side starting the race and carrying it on to an agreed point, where another takes it up to another point, there to be relieved by a third, until the final objective is reached. In ancient times, before the advent of more rapid carriers, relays were used for practical purposes in carrying messages. At present, relay races are merely sporting contests. The exact date of their beginning is uncertain. In the United States they appeared at about 1890, and in 1898 the New York Athletic Club established a mile record of 3 min., 21 $\frac{2}{5}$ sec. In relay races on the yardage basis the United States holds the records:

Distance	Country	Time	Year
440 yards . . .	United States	41 sec.	1927
880 yards . . .	"	1 m. 25 $\frac{4}{5}$ sec.	1927
1 mile . . .	"	3 m. 13 $\frac{2}{5}$ sec.	1928
2 miles . . .	"	7 m. 41 $\frac{2}{5}$ sec.	1926
4 miles	"	17 m. 21 $\frac{2}{5}$ sec.	1923

The records on the metric basis are:

400	United States and Germany	40 $\frac{4}{5}$ sec.	1924-1928
800 . . .	United States	1 m. 25 $\frac{2}{5}$ sec.	1927
1600 . .	United States	3 m. 13 $\frac{2}{5}$ sec.	1928
3200 . .	United States	7 m. 41 $\frac{2}{5}$ sec.	1926
6000 . . .	Finland	16 m. 11 $\frac{2}{5}$ sec.	1926

These are the records up to Dec. 31, 1931. Among the college records, on Apr. 19, 1930, Illinois did the 440 yards in 41 sec.; on Apr. 26, 1930, Ohio State did 880 yards in 1 min., 26 $\frac{8}{10}$ sec., and Missouri did a mile in 3 min., 17 sec.

RELAYS, electro magnetic devices which open or close contacts in an electrical circuit when, in a given circuit, a change, or an abnormal condition, occurs in the current flow, or potential. Hence, a small energy in the relay winding may control large amounts of power through the contacts. Common types are *overload*, *differential* and *reversed current*. Relays are essential to the operation of TELEPHONE and TELEGRAPH systems, and to the protection and continuity of operation of electrical power transmission networks. C. L. D.

BIBLIOGRAPHY.—*National Electric Light Association Relay Handbook*, 1926

RELEGATION. See EXILE.

RELIGION. In dealing with religion, it is convenient to separate the historical and the philosophic

aspects of the subject. The anthropologist, the sociologist, the psychologist, as well as the historian, have been concerned with the former, while the philosopher and the theologian have been interested in the latter.

Historical. As a result of the studies of the last three quarters of a century there is now open to the student of religion a vast mine of information concerning the religions of the various peoples of the world, past and present, savage and civilized. These researches have been guided by a general conception of evolution, and while the facts have not justified any belief in a uniform, gradual and progressive development, they have shown that religion has evolved with civilization and is intimately connected with the intellectual, moral, social, political and cultural life of the race.

The most determinative idea in the history of religion is the conception of God, and its development is bound up with the emergence of a belief in a spiritual monotheism. Not all peoples have reached this level, and even amongst those races where the idea is part of their central teaching many individuals have failed to grasp it. The paths along which the race has traveled to reach this conception are in the main three.

(1) *God in Nature*. There was a stage in primitive culture where man regarded the objects of nature, as the sun, moon, rivers, clouds and trees, as alive or the abode of spirits. These spirits were responsible for all the movements of nature, and along with the spirits of the departed, helped or hindered man in the business of living. Tylor gave the name animism to this stage of culture, and man's early religion grew around these animistic beliefs. These spirits were his gods. There were many of them, and they acted arbitrarily. As man conceived of them after the fashion of persons he could have no very lofty ideas about them, for his own moral and intelligent nature was scarcely awake. However, their favor was important to the success of his enterprises, and through his worship of prayer and sacrifice he sought to win their aid.

As man's intelligence developed, this primitive idea passed away. He always retained the idea that nature was unintelligible apart from spirit; but his conception of the nature of spirit was completely changed. As he came to recognize the presence of law and order in the world and to see the significance of reason in human life, he abandoned his belief in the arbitrary actions of the gods, and sought to bring order into the spiritual world. When finally, as among the Greeks, he recognized that the world in which he lived was a cosmos, that is, a single system of ordered relations, he asserted this belief in one God who was the intelligent ground of the universe.

(2) *God in Society*. Primitive man also gained a vision of God in human nature. In the family life he early became aware of a spiritual reality greater than himself, which disciplined his waywardness and

at the same time called forth his loyalty to a larger and better life. At that level he spoke of the god of the family, and as the family passed into the tribe and the tribe became a nation, he became more conscious of a purpose working through history and of a power that guided the destinies of peoples, and he then thought of the god of the tribe or of the nation. This development is illustrated in the religion of Egypt. At one time each of the 42 towns scattered along the banks of the Nile had its own local deity. Later, when these towns were federated into two provinces, Horus emerged as the god of Lower Egypt, while Set appeared as the lord of the southern province. When Menes, about 3300 B.C., brought about a federation of the two provinces, one God, Horus-Set, was recognized by all of Egypt. Finally, in the 15th Century, B.C., the Egyptian Empire was established. This covered the whole known world, and Amenhotep III proclaimed one God for all the nations of the world.

In tribal and national religion God was linked up with the destinies of a people. He was concerned with their welfare, went with them on their journeys or into battle, and demanded of them their loyalty and obedience. A stately ritual which disciplines the individual and makes him conscious of his solidarity with the tribe or nation grew up in these faiths. The battlefields became sacred shrines, and the anniversaries of victories became sacred days when the power of the god was exalted and his guiding hand on the affairs of the nation was proclaimed.

(3) *God and the Moral Idea.* The rise of the moral consciousness was perhaps the most significant factor in the development of religion. In a certain sense man had always had a moral consciousness, for he had distinguished between the good and the bad. At first he thought of the good as that which satisfied his desires and the bad as that which frustrated them. Primitive society also had its own standards, its traditions and customs, and in terms of these commended the obedient and condemned the disobedient. It is a long way, however, from this level to the stage where man recognized that goodness and badness were matters of character and made the distinction between physical goods like wealth, prosperity and security, and moral qualities like justice, honor and integrity. When, however, such a level had been reached, and man recognized the pre-eminence of virtue, he was aware of a new reality in the world. Unlike the material world, the realm of morality was intangible and invisible, but it was none the less real or binding. The individual or the society which sought to defy it eventually met with defeat; but those who conformed their lives to it found in it the path of true development.

This idea of morality brought with it a new vision of God which revolutionized religious thought and action. God was no longer regarded as possessing a local habitation or as belonging to any one people. Men now saw Him as the Eternal Spirit of Righteousness and of Justice. And as there was only one moral

code for all the world, there was only one God before whom all men were equal. Sacrifices and burnt offerings became irrelevant to His worship, and stately ritual was subordinated to purity of heart and uprightness of life. Prayer ceased to be a request for material prosperity and became the struggle of man to conform his life to the holy will of God and to participate in the divine life.

This moral conception of God has been attained, in some measure, by all the higher religions of the world; but the western world owes it primarily to the Hebrew prophets. Their teaching was accepted by Jesus and found completion in his thought of God as Love. Instead of regarding God in terms of a just and stern judge, who punished the evil and rewarded the good, he thought of Him as a Father who was concerned in the restoration of His erring sons to spiritual health.

Philosophic. Because of his desire to teach the faith to other people or to satisfy his own intellectual curiosity, the theologian has sought to define religion in intelligible terms and to show its relation to the rest of life. The various conceptions that have been offered center around three main ideas.

(1) *Religion as Creed and Dogma.* This conception has been consistently maintained by the ROMAN CATHOLIC CHURCH and by those branches of the Protestant Church represented by the Anglican and the Reformed churches, and in more recent times it has appeared in Evangelical Protestantism through the fundamentalist movement. This view lays emphasis upon the objective aspects of religion and insists that religion involves beliefs concerning the nature of things, particularly about God and His activity in the world. While not hesitating to appeal to philosophic arguments to justify the central emphasis upon the element of objectivity, the exponents of this view have usually defended the particular tenets of their creeds by an appeal to a supernatural revelation or to the tradition of an historic church.

Faiths that insist upon the primacy of the creeds also stress the institutional side of religion. The creeds are the platform of the church, and they furnish a rallying point for its members. On the other hand, the church is regarded as the guardian of the sacred deposit of truth which was given to it by its Founder, and it is concerned to maintain the purity of the faith. It accepts views in harmony with its central doctrines and condemns as heresies those judgments which are out of harmony.

(2) *Religion as Faith or Individual Experience.* This view centers around man with his desires and his aspirations. Its exponents believe that man is a spiritual being with an inner life of motive and desire which can be understood only in terms of purposes and ideals; that religion is primarily concerned with the life of this inner spirit, and that its task may be defined in terms of the transformation of the sinful life, the development of a noble character and the cultivation of the Christian virtues and graces. According to them religion needs no external au-

thority either of church or Scripture, for man as a spiritual being possesses the ability to distinguish the true from the false, the good from the bad, and to recognize the voice of God speaking within his own soul.

In focusing religion in man rather than in God, and stressing the individual rather than the community, the exponents of this view turn away from the creeds, pointing out that the intellectual assent to a proposition does not necessarily involve the elevation of the life. Religion is the literature of life, while the creeds are only its grammar. Grammar may be taught, but the best teacher of literature can do is to awaken in the pupil the appreciation for good literature. Religion must be caught and not taught, and is best propagated by exposing men to lives that have been transformed by the spirit of God.

In modern times, consistent with this outlook, religion is said to depend upon religious experience. An earlier usage spoke of it in terms of feeling, and when the active elements of the inner life were stressed, it was described as a faith.

(3) *Religion as Conduct.* There has ever been a class of men who have turned away from the creeds because of their logic chopping, and have been suspicious that the life of piety and devotion lacked the elements of reality. They have been practical men who have been concerned with the world's work, and they have turned to religion because it has developed the good citizen. They have seen that the religious man is honest and law-abiding, and that he develops a community and a civilization where men can live the good life. Religion is for them a type of conduct. "Pure religion and undefiled before God and the Father is this," says St. James, "To visit the fatherless and widows in their affliction, and to keep himself unspotted from the world." (James 1:27.) While as a general rule these people have accepted the belief in God as in some way the foundation of morality, their main concern has been with the practical conduct engendered by religion. This specific approach to religion cuts across all ecclesiastical lines and finds expression in all denominations at various times. In the last half century it has found voice in all the Christian communions through the emphasis upon social service.

These three conceptions of religion lie at the foundation of much of the theological controversy of the ages. In reality, however, they are but three aspects or fragments of religion which are integrated in the fully developed religious personality. They correspond to and are bound up with interpretations of human nature in terms of intellect, feeling and will. As one views human history one realizes that any interpretation of humanity which subordinates any one of these elements to the others is inadequate. Similarly in the interpretation of religion, these conceptions are not antagonistic, but supplementary and complementary. Religion springs from a spiritual interpretation of nature, man and human history; and the idea of

God is the determinative conception of all religious development. This is the truth that is emphasized by those who make creeds and doctrines central to the religious life.

Nevertheless, creeds and dogmas are abstract and formal, and no creed can ever embody the whole truth of religion. It is ever the characteristic of religion that it widens the horizons and lengthens the vistas of man. It always has in it more than the human race at any moment grasps. It awakens the longings, the aspirations and the idealism of man. While it binds him to the past, it also links him up with the future. It is a process of finding and then seeking again. A rich and well-rounded religion will embody itself in institutions; but a vital religious faith lives only in persons whose spiritual nature it has awakened, and whose idealism it has challenged.

Man, however, lives his life amidst constantly changing social conditions. His inner life by itself is abstract and impotent. It becomes vital and effectual as it incarnates itself in conduct and through specific acts enters into the current of civilization. No intellectual formula can show how these elements of religion are united. Each man integrates them for himself, and as he grows in his spiritual life, he finds that his religion has become for him "the way, the truth and the life."

W. T. B.

BIBLIOGRAPHY—A. Sabatier, *Outlines of a Philosophy of Religion*, 1897, 1913; C. H. Toy, *Introduction to the History of Religions*, 1913; G. Galloway, *Philosophy of Religion*, 1914; G. F. Moore, *History of Religions*, 1914-1920; R. H. Lowie, *Primitive Religion*, 1925; E. S. Ames, *Religion*, 1929.

RELIGIOUS EDUCATION. If religion be defined as a collection of customs and sacred rites regulating life accompanied by certain forms of worship, then the earliest forms of education were religious. With the development of the theocratic state among the Jews and later in the medieval period, all education was dominated by religious aims and purposes, and the Church claimed either the sole right of providing it or the right to supervise teachers and schools, if they were provided from other sources. With the Reformation a new political concept of the state was held and a partnership between State and Church was introduced. Under this form the state undertook the provision of education gradually; but its supervision continued under the control of the Church, and the chief end of education was still religious although under the new principle that the state could decide on the particular form of religion that it would adopt and tolerate. This principle has survived in many countries, especially the Protestant countries, down to the present except where, largely under the influence of the French Revolution, the claims of the secular state have been asserted. But even in those countries where this principle has survived, the rights of all denominations to provide the religious instruction of their sect have been recognized.

Germany. Germany furnishes the best example of a practice found also among her neighbors; here religious instruction has always enjoyed a place in the curriculum of all elementary and secondary schools.

The former are organized either on a denominational basis, i.e. *Konfessionelle Schule*, Protestant, Catholic, and Jewish, or on an interdenominational basis, *Simultanschule*, the pupils being given religious instruction by representatives of their own sect. The secondary schools are interdenominational. The Weimer Constitution of 1919 retained this system under the Republic but added two new provisions: a conscience clause for pupils and teachers, and permission to organize schools according to a particular *Weltanschauung* where the request was made by a sufficient number of parents. From 1921 to 1928 unsuccessful efforts were made to secure the enactment of a bill, the *Reichsschulgesetz*, in which it was proposed to organize the whole system on a denominational basis, as are the schools of Holland.

England. The English system represents a mixture of sectarianism and secularism. Until 1870 the majority of the elementary schools had been provided by denominational groups, which continued to maintain schools after the Act of 1870 provided for the establishment of elementary schools at public expense. By the Cowper-Temple Clause of this Act "no religious catechism or religious formulary distinctive of any particular denomination shall be taught in the (public elementary) school." When the Act of 1902 laid the basis for a national system the two types of schools, the provided schools in which Bible reading without comment is permitted, and the non-provided schools which are sectarian, were retained. Both are maintained by public taxation, but the non-provided schools retain certain rights in the appointment of teachers and certain duties as to the maintenance of the buildings. At present there is an agitation to have the denominational schools taken over wholly by the public authorities and to conserve their claim to religious instruction. In the secondary schools denominational religious instruction is not given in public institutions.

France, Italy and Russia. France adopted a lay system of schools from the foundation of the Third Republic and in 1904 prohibited religious orders from maintaining schools, although parents are not prohibited from having religious instruction given to their children outside of school hours. In Italy the Gentile Reform of 1923 retained religious instruction in the schools as an essential part of Italian culture; gradually, however, the Church asserted its claim to supervise it and to approve textbooks and courses of study, a claim confirmed by the Concordat of 1929. Religious instruction is prohibited in Russia under the new regime.

The United States. The public school system of the United States was secularized after years of conflict about the middle of the 19th century, and sectarian instruction of any kind is prohibited in most state institutions. The establishment of denominational schools, however, is nowhere prohibited, and an attempt made in Oregon to require all children up to 16 to attend public schools was declared unconstitutional in 1924. The exclusion of religious in-

struction from the public schools has imposed on denominational groups the responsibility of providing it in other ways. The Roman Catholic Church has increased the number of its PAROCHIAL SCHOOLS. Through the cooperation of other denominations opportunities have been increased for Bible reading in schools. This was required in 1927 in 11 states, specifically permitted in seven states, and permitted by custom in 21 other states. Since 1910 there has been a rapid growth in the number of states and high schools which give high school credit for Bible study. Finally, there has been a widespread movement to improve the organization, courses of study, qualifications of teachers, and methods of instruction in Sunday and week-day religious schools which are conducted after public school hours or in many states, by statute or with approval of the educational authorities, in public school time within certain limits.

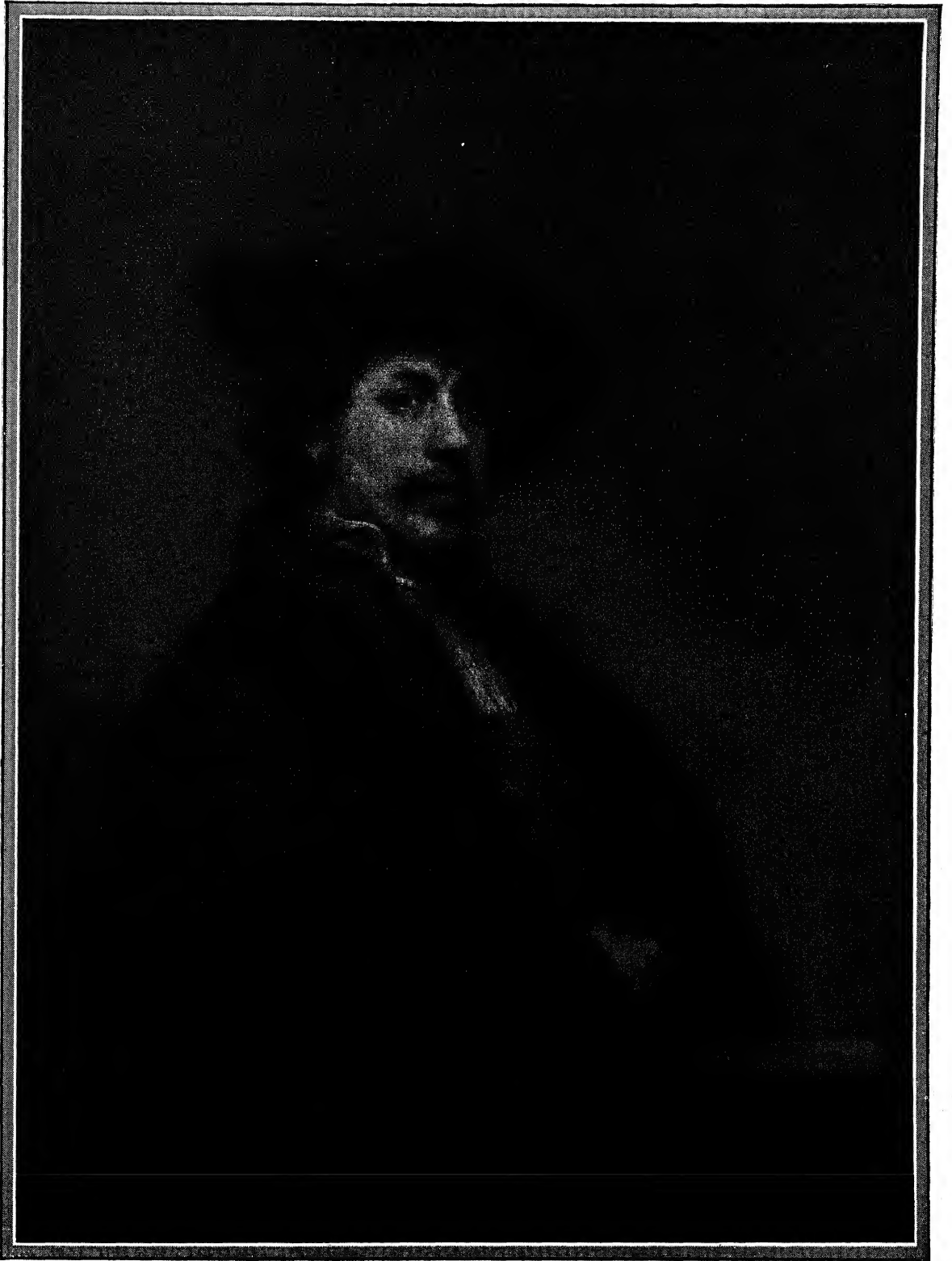
In general the whole problem of the aims of religious education is determined by the character of a particular sect or denomination. The orthodox or conservative, which stress the predominant importance of religion over the whole of life, emphasize indoctrination in certain forms of belief, in dogmas, in religious customs and practices. The general tendency, however, of religious pedagogy is to shift the emphasis from the forms, practices and dogmas of religion to its influence as a form of living or interpretation of life. Knowledge and practices do not cease to be important; but the emphasis is rather on the interpretation of religion to develop a more complete personality, to promote habits, attitudes and ideals, to assist in the advancement of social progress in all its relations, and to cultivate a sense of universal brotherhood and a higher humanity on a spiritual basis derived from the religious prophets, leaders and heritage of the world.

The interests of religious education are permitted in the United States by the Religious Education Association, organized in 1903 under the stimulus and advice of William Rainey Harper, then president of the University of Chicago, and by the International Council of Religious Education, organized in 1922 by a merger of the International Sunday School Association and the Sunday School Council of Evangelical Denominations.
I. L. K.

BIBLIOGRAPHY.—Archbishops of Canterbury and York, *Church Assembly Report of the Commission on Religious Education*, 1929; H. F. Cope, *The Week-Day Church School*, 1921; J. K. Jackson and C. F. Malmberg, *Religious Education and the State*, 1928; *Religious Education* (journal of the Religious Education Association), see especially Vol XXIII, which contains articles on 25 years of religious education; T. G. Soares, *Religious Education*, 1928.

RELIGIOUS SOCIAL WORK. Social work, defined as including social education, is carried on under Protestant auspices denominationally, through institutions—hospitals, sanitariums, orphanages, settlements, homes for the aged,—and national and regional departments of social service or home missionary agencies which hold conferences and circulate literature; interdenominationally, through city and

REMBRANDT VAN RYN



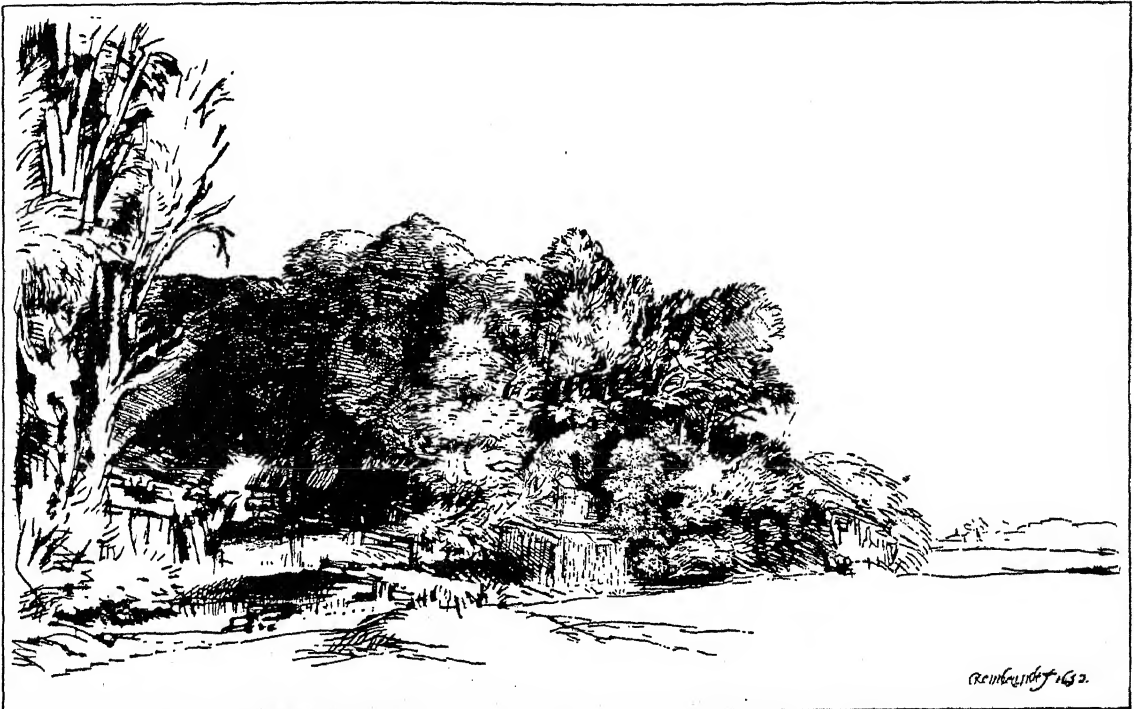
"PORTRAIT OF THE ARTIST BY HIMSELF"

By Rembrandt Van Ryn (1607-69). In the National Gallery, London.

state federations (councils) of churches cooperating with community social agencies in relief, employment service, hospital and prison work, and through the Federal Council of Churches and affiliated national bodies, by means of education, research and technical counsel. Protestant denominations maintain a Church Conference of Social Work in connection with the National Conference of Social Work. The Protestant trend is toward socializing the entire church program rather than increasing institutional service.

Catholic social work is carried on by diocesan conferences of Catholic charities federated in the National Conference of Catholic Charities, and through a large number of Catholic welfare institutions; also,

to his working with Van Swanenburch at Amsterdam. Returning to Leyden in 1623 he applied himself to unremitting studies of chiaroscuro, and, painting heads from life, gradually became known as a portrait painter. Some of his most admired works are of this period. In 1630 he settled in Amsterdam, and 4 years later married Saskia van Uylenborch. Rembrandt's reputation grew rapidly, as did the demand for his works. Regardless of cost he had collected works of art, and lavished jewels on his young wife. But debts increased steadily, and in 1656 he was declared insolvent. These misfortunes did not diminish his output, and the number of portraits from his brush is astounding. When sitters were lacking he painted



COURTESY METROPOLITAN MUSEUM OF ART

A CLUMP OF TREES
An etching by Rembrandt Van Ryn (1606-1669)

educationally, through the National Catholic Welfare Conference and affiliated organizations. Catholic social work is much more highly specialized than Protestant.

Jewish social work is conducted mainly on a racial rather than a religious basis. Recreational work is carried on by institutional synagogues; social education on a religious basis is conducted by the Central Conference of American Rabbis. F.E.J.

BIBLIOGRAPHY.—F. E. Johnson, *The Social Work of the Churches*, 1930; Father J. O'Grady, *Introduction to Social Work*, 1929.

RELUCTANCE. See MAGNETIC UNITS.

REMBRANDT VAN RYN (1606-69), greatest of Dutch painters, was born at Leyden, July 15, 1606. He was sent to the Leyden Latin School, preparatory to studying law. His strong taste for art, however, led

the long series of portraits of himself, which are among the greatest glories of art. His religious and subject pictures are numerous, and his noble poetic landscapes unsurpassed. As an etcher he is the supreme and unequalled master of the needle. Of his earlier works, *The Hague Anatomical Lecture*, dated 1632, is representative, and the *Amsterdam Night Watch*, 1642, shows his ripened talent. The *Amsterdam Jewish Bride* is one of his last efforts. Rembrandt's later years were embittered by troubles with his son Titus. His vogue had completely gone, both health and eyesight were failing, and his business incompetency involved him in endless lawsuits. Hendrickje, his faithful second wife, died about 1662. Rembrandt died at Amsterdam on an unrecorded day in 1669, and was buried in the Westerkerk, Oct. 8. All later art has been profoundly influenced by Rembrandt. His strik-

ingly individual handling of pigment, the rich characteristic glow, together with strong contrast of light and shade, are apparent in all his work. And to this must be added his unflinching interest in psychology and the profound hidden meaning which exists below the surface. As a master of every resource of his art he is second to none.

REMEMBRANCE OF THINGS PAST (*À la recherche du temps perdu*), an autobiographical work in 15 volumes by MARCEL PROUST, published 1913-26. This novel, depending entirely upon the play of memory, has carried psychological analysis to new heights. Although the "I" of the story is the most important character, there are numerous other personages who attend this hero from childhood to middle age, notably his grandmother and his mother. Others include M. Swann and his wife, the courtesan Odette; M. de Charlus; the de Guermantes; Gilberte, Swann's daughter, and Albertine, the narrator's last mistress. All except the last volume of the series have been translated by C. K. Scott Moncrieff; *Swann's Way*, translated 1922; *Within a Budding Grove*, 1924; *The Guermantes Way*, 1925; *Cities of the Plain*, 1927; *The Captive*, 1929; *The Sweet Cheat Gone*, 1930, and *The Past Recaptured*, 1932.

REMIGIUS, ST. (c. 437-533), bishop of Reims and apostle of the Franks, was born in Gaul about 437. He became archbishop of Reims when he was only 22 years old; but his chief title to fame rests on the fact that he converted King Clovis and his entire band of Franks to Christianity. He died on Jan. 13, 533; but his feast day is kept on Oct. 1. His name is especially venerated in French churches.

REMINGTON, FREDERIC (1861-1909), American painter, sculptor and author, was born at Canton, N.Y., Oct. 4, 1861. He studied at the Yale Art School and the Art Students' League, New York. Due to ill-health, he went West and became a cowboy. From this life he derived inspiration for his celebrated frontier pictures. His *Cavalry Charge on the Southern Plains* is in the Metropolitan Museum, New York. Remington's sculptures include *The Broncho Buster* and *The Wounded Bunkie*. He wrote and illustrated *Pony Tracks*, published 1895, *Crooked Trails*, 1898, and *Frontier Sketches*. Remington died at Ridgefield, Conn., Dec. 26, 1909.

REMINISCENCE, the recognition of ideas; the remembering of past experience. The first conception is Platonic and epistemological, the second psychological and the more common use of the term.

From Plato's point of view there could be no cognition without recognition. Knowledge was recognition, i.e., it was the recognizing of ideas which had been known in some previous existence. The term reminiscence refers to such recognition. (See PLATO.)

Psychologically reminiscence is simply a phase of memory. The factors entering into recall are also factors of reminiscence. Forgetting and memory curves vary with age, sex and other factors. Considering the retention property of nervous matter the marvel is not that reminiscence takes place but that

anything is ever forgotten; yet in the normal functioning of memory forgetting is just as essential as remembering.

REMIZOV, ALEXIS MIKHAELOVICH (1877-), Russian poet and novelist, was born June 20, 1877, in Taganka, the so-called East End of Moscow. He grew up in poverty, which is reflected in his early fiction. In 1897 he was banished to the provinces, which were used later as the background for his short stories. In 1923 he settled in Paris. Remizov became the head of a new school of fiction in his attempt to create what is known as the "spoken form" of the written language.

REMORA, a remarkable family (*Echeneidae*) of spiny-rayed, oceanic fishes widely distributed in tropical seas, called also shark suckers. They are slender in form with the lower jaw projecting far beyond the upper, the mouth large and provided with numerous small, pointed teeth, and the coloring in most cases uniformly dusky, with the lower portion of the body as dark as the upper. The top of the head and neck is provided with a peculiar, flat, suction disk, probably a modification of the first dorsal fin. By means of this powerful disk the remora clings to large, free-swimming fishes and occasionally to ships and other floating objects, and is thus carried about for great distances. Remoras, however, are not parasitic on their hosts but feed chiefly upon various small fishes. Common species of North American waters are the shark remora or pegador (*Echeneis naucrates*), almost cosmopolitan in range and found exclusively on the larger sharks, with a very slender body about 2 ft. long, of a general sooty color with a dark, white-edged stripe on the side, and the swordfish remora (*Remora brachyptera*), about a foot in length, reddish-brown above and darker below, also of wide distribution.

REMOUNT SERVICE, ARMY, a branch of an army engaged in supplying horses and mules to the other branches of the army. Usually these are obtained by purchase from the horse or mule raisers of the country. Frequently the remount service trains the animals. It is closely associated with breeders and in some countries conducts breeding operations of its own.

REMOVAL FROM OFFICE. Three major methods of making removals from public office exist in the United States: legislative, executive and judicial. The Federal Constitution describes the first of these processes, "The House of Representatives . . . shall have the sole power of impeachment. . . . The Senate shall have the sole power to try all impeachments. When sitting for that purpose they shall be on Oath or Affirmation. When the President of the United States is tried the Chief Justice shall preside. And no person shall be convicted without the Concurrence of two thirds of the members present." A second variation of legislative action which is to be found in some jurisdictions is that of removal upon joint or concurrent resolutions. The power of the President to make removals from the Federal administration is

practically unlimited. Such is not the case of the chief executives of all the states. In some, the governor may only suspend but not remove such officials pending a final decision by the legislature or the courts upon the validity of the charges. In addition the statutes in many of the states provide for the automatic removal of any officer convicted of misfeasance, malfeasance, or nonfeasance in office. S. C. W.

REMSCHEID, a German city in Rhenish Prussia near Düsseldorf. It attained industrial importance through Huguenot immigration in the 16th century and became a city in 1808. Lennep and Ludringhausen were merged with it 1929. The Mungstener Bridge, the highest in Germany (348 ft. above the River Wupper), is located in Remscheid. It is an important center of the tool industry and of small commodities such as screws, files, skates, cutlery. Motors and motor vehicles are manufactured here also. Pop. 1925, 99,755.

REMSEN, IRA (1846-1927), American chemist, was born in New York City, Feb. 10, 1846. He was educated at the College of the City of New York, Columbia University and abroad at Munich and Göttingen, where he received his Ph.D. in 1870. In 1876 he was appointed professor of chemistry at Johns Hopkins, becoming its president in 1901, and retiring from both positions in 1913. He founded the *American Chemical Journal* and, apart from his many papers and textbooks of chemistry, is perhaps best known through the discovery of saccharin. He died at Carmel, Calif., Mar. 5, 1927.

REMUS, in mythology, the twin brother of **ROMULUS**.

RENAISSANCE, THE. As an historical period, the Renaissance includes the 14th, 15th and first half of the 16th centuries of Italian history. As a cultural movement, it signifies the great awakening in art, literature, social life and free speculation which took place during those years. The term is also applied loosely to the corresponding movement, slightly later in time, in Northern Europe. The word renaissance means a rebirth. It was first applied by historians who considered that age a rebirth of the great civilization of ancient Rome and Greece, after a period of intellectual sterility, called by them the Middle Ages. This conception, however, has been abandoned by modern scholars. The period of the Renaissance was rather an age of very rapid transition from one type of civilization to another radically different, from the medieval to the modern. Much that was medieval still persisted, while many new factors, significant for the modern age, were coming to birth. It was an age of confusion and unrest, but illuminated and inspired by a great intellectual liberation. It was also more than a mere transitional period, for it produced a culture characteristically its own.

As the period of the Middle Ages drifted into that of the Renaissance the intellectual and social synthesis built up around the universal Church and **FEDERALISM** began to disintegrate, giving freedom to the play of new forces. The Church lost much of its international authority, in conflict with the rising power

of the national states during the Babylonian captivity of the papacy at Avignon, 1305-77, and the **GREAT SCHISM** which followed, 1378-1418. But the greatest dissolvent of the old, and the most potent factor in creating the new civilization, was the rapid growth of commerce, industry, wealth and city life. This had begun in Italy in the 12th and 13th centuries to bear its full fruit in the Renaissance. The increase in material prosperity created a wealthy, leisured society of city dwellers, who had time and opportunity for the pursuit of a secular culture freed from Church control. It afforded greater comfort and luxury and inspired a new taste for the physical pleasures of this world. It ended the isolation of the medieval nobility, who now moved from their fortified castles to the towns. It brought all classes together in constant contact and permitted a swifter circulation of ideas. It afforded opportunities for social advancement through the acquisition of wealth. Birth ceased to be as important as it had been. The class lines of the Middle Ages were broken down, giving way to a new, fluid and more homogenous society. "The Middle Ages had been an age of societies; the Renaissance was an age of society."

In this new urban society created by wealth, the individual was allowed free play for the expression of his own personality, and gained a new self-consciousness. Filled with enthusiasm and a driving curiosity by the new vistas of human interest opening up before their eyes, men strove to develop all their faculties and to exercise all their talents. Self-conscious and self-confident, they broke with the tradition of their ancestors. The desire for immortal fame overshadowed the desire for eternal salvation. There were very few saints in Renaissance Italy, but many men of amazing versatility and tireless energy.

Political Aspects. From the political point of view, the Renaissance has been aptly called the Age of the Despots. The Italian cities had secured their independence during the long struggle between the papacy and the Holy Roman Empire in the 12th and 13th centuries. Originally small republics, most of them had fallen into the hands of despotic rulers, the supreme individualists of the age. Under the illegal rule of the despots, all classes were leveled to an equality of political impotence. During the 15th century, the stronger city-states conquered the weaker, until most of the peninsula was partitioned among five territorial states: the oligarchical republic of Venice; the Duchy of Milan, ruled by the despotic families of Visconti and Sforza; Florence, nominally a republic but ruled by the Medici; the Papal States, and the Kingdom of Naples. In 1494 began a series of foreign invasions which, after a generation of constant warfare, left Italy a conquered country in the hands of the Habsburg dynasty.

In the sphere of economic activity, the Renaissance marks a transition from the guild organization of commerce and industry to the capitalistic system of modern time. Economic power passed from the corporation to the individual, widening the gap be-

tween the employer and worker, and creating the modern classes of bourgeoisie and proletariat.

Interest in Antiquity. Perhaps the most characteristic aspect of Renaissance culture was the great revival of interest in Greek and Roman antiquity, from which the age takes its name. It had a great influence in shaping the thought of the period, but was itself a result of other factors rather than a cause of the movement as a whole. Latin had been in common use throughout the Middle Ages, and the classic authors had always been available. But they could be neither fully understood nor appreciated until a society had been created similar to that of ancient Rome, in which material interests preponderated over the spiritual and in which the individual was allowed full expression of his peculiar personality. When such a society began to evolve in the 14th century, men like PETRARCH and GIOVANNI BOCCACCIO found in the Latin classics a social philosophy that fulfilled their own unshaped desires, a model for their imitation and a goal for their aspirations.

The Humanists. These pioneers were followed by generations of eager scholars, who called themselves Humanists, that is students of the *litterae humaniores*, the literature that dealt with humanity. From the death of Petrarch, 1374, to the accession of LORENZO DE' MEDICI, 1469, Italian intellectual activity was almost wholly absorbed in the colossal task of collecting and editing ancient manuscripts, of developing a pure classic style and of restoring classic syntax and grammar. The writing of this period, though voluminous, was mostly imitation or pedantic scholarship. Yet the early Humanists performed a great service in preserving the magnificent heritage of ancient culture and in placing it at the disposal of the modern world. Most of the great names of this age in scholarship, POGGIO BRACCIOLINI, Francesco Filelfo, Leonardo Bruni and Leo Battista Alberti, are connected with Florence and the patronage of Cosimo de' Medici, though there were scholars in every city and at Rome LORENZO VALLA was instilling into Humanism a new critical spirit. It was left to the generation that came of age with Cosimo's brilliant grandson, Lorenzo the Magnificent, to use the new learning and the discipline of classic style for the expression of original ideas characteristic of their age. To this period belong the Platonic philosophers, DELLA MIRANDOLA GIOVANNI PICO and MARSILIO FICINO, the poet ANGELO POLIZIANO and the political theorist NICCOLO MACHIAVELLI.

Greek Humanism was a later development than the Latin. The first Greek teacher at Florence was Manuel Chrysoloras, who began his work there in 1397. A further impetus to Greek studies was given by the oecumenical council of the Greek and Roman churches at Florence in 1437 and by the fall of Constantinople, which drove hundreds of Greek refugees to Italy in 1453. By the second half of the 15th century, Greek shared with Latin the enthusiasm of the Humanists, and both languages were considered essential to the educated men.

The age of the Renaissance saw also the birth and growth of a literature in the Italian tongue. Hampered by a variety of dialects, Italian literature had made little progress till the early years of the 14th century, when Dante's (*see* DANTE, ALIGHIERI) great poem, the *Divine Comedy*, fixed the Tuscan dialect as the national literary language. Petrarch and Boccaccio continued this work with great success in the next generation. After their death, however, Italian was ignored in favor of the classics, until the second half of the 15th century when the lyric poems of Poliziano and Lorenzo de' Medici, the epic poetry of MATTEO MARIO BOIARDO, Ludovico Ariosto and later Tasso, and the prose of Machiavelli and the historian FRANCESCO GUICCIARDINI placed the national tongue on an equal footing with Latin and Greek as a medium of literary expression.

Renaissance Art. But the greatest glory of the Renaissance was its art. Never in the history of the world has one country in so short a time, with the possible exception of Athens in the age of PERICLES, produced so many masters in the fields of painting, sculpture and architecture. The revolt from medieval tradition and authority, the new interest in humanity and natural beauty, the influence of classical models and the pagan spirit, the existence of a cultured and wealthy society and the joyous energy of an age of discovery all contributed to making the Renaissance a great epoch in the history of art. After nearly two centuries of experimentation and technical improvement, Renaissance art reached its highest point with the last years of the 15th century and the first quarter of the 16th. MICHELANGELO and LEONARDO DA VINCI, two of the most versatile geniuses in history, created masterpieces in all three of the fine arts, while in painting SANZIO RAPHAEL, Correggio and a score of others established their position as masters for all time.

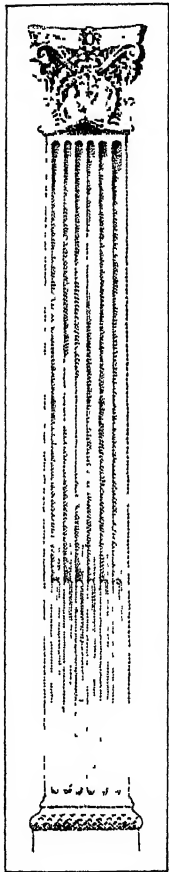
With the Habsburg conquest of Italy and the beginning of the repressive Counter-Reformation, the fire of the Renaissance spirit was slowly quenched. But intellectual forces had been loosed which would continue to affect profoundly the thought of the modern world. The Renaissance crossed the Alps and bore fruit in the Humanism of France and Germany and in the literature of Elizabethan England. In the freedom and curiosity of the Renaissance mind, the modern scientific spirit was cradled and had passed its infancy before the 16th century was over. The explorers like CHRISTOPHER COLUMBUS, who discovered a new world, were followed in the next century and a half by scientists like NICOLAS COPERNICUS and GALILEI GALILEO, who discovered a new heaven, and WILLIAM HARVEY, who discovered the true nature of a man's body.

W. K. F.

BIBLIOGRAPHY.—J. A. Symonds, *Renaissance in Italy*, 7 vols., London, 1875-86; J. Buckhardt, *The Civilization of the Renaissance in Italy*, trans. by S. G. C. Middlemore, London, 1878, and following editions; H. O. Taylor, *Thought and Expression in the Sixteenth Century*, 2 vols., 1920; P. Monnier *Le Quattrocento*, 2 vols., Paris, 1924; L. Thorndike, *Science and Thought in the Fifteenth Century*, 1929

RENAISSANCE ARCHITECTURE, the style of architecture of the great classic revival that swept over Europe in the 15th and 16th centuries, became part of the general European tradition, and persisted in a direct line of development until the French and American revolutions. Occasionally the term has been limited to the early phases of this development, prior to the **BAROQUE STYLE**. Here however, the more general usage of the term will be adopted.

In general, Renaissance architecture meant the abandonment of Gothic traditions, and the turning back to the forms of ancient Rome for architectural inspiration. It rarely attempted the actual copying of ancient forms or building types. Renaissance architecture reflects the individualism of the time, and its love of order, symmetry, luxury and grace. It sought primarily for beauty of surface and composition, monumentality and elegance, making structure and engineering definitely secondary, rather than, like the Gothic, developing aesthetic qualities from the structural forms. For the historical background, see **ARCHITECTURE, HISTORY OF**, and **RENAISSANCE**.



15TH CENTURY
FLORENTINE PIL-
ASTER

Renaissance in Italy. F. BRUNELLESCHI, often called the father of the Renaissance, went to Rome in 1403 with the young Donatello to study Roman antiquities. On his return he used the inspiration of Roman scale and structure in his design for the dome of the Cathedral at Florence, and Roman ornamental forms inspired the domical Pazzi Chapel, about 1420, and the basilican churches of San Lorenzo and San Spirito, all in Florence. From his time on similar inspiration produced similar motives, though with increasing ease and grace, in the work of many of his contemporaries and followers. B. da Maiano (1442-97), M. Michelozzi (1391-1472), Mino da Fiesole (1430-84), Il Cronaca (1457-1508), and Luca della Robbia (1400-82), all designed in the new manner in Florence, producing work of lovely delicacy, in which Corinthianesque pilasters, pediments, cupids and classical moldings were used with creative zest in new combinations. Leon B. Alberti (1404-73) went further, and thinking more architecturally produced in his exterior of the church of San Francesco at Rimini, and in San Andrea at Mantua, Roman dignity and power as well. These men were soon followed by others elsewhere, and by

the end of the century all central and northern Italy was using the new style. In general, Florentine models were followed; but early Roman work tended to follow Roman ruins more closely, as in the Palace of Venice

at Rome. In Venice, the Byzantine tradition led to the use of the applied richness of encrusted marbles, and produced such exquisite work as Santa Maria dei Miracoli, about 1490, and the rich Vendramini palace with its columns and balconies, both by Pietro Lombardo (1433-1515). In Lombardy, the greater strength of Gothic tradition shows in the pointed arches with classic decoration of the Great Hospital in Milan, by Filarete (1400-68), and in the cloister of the Certosa at Pavia. The rich church façade of the Certosa, begun in 1476 by Il Bergamesco and others, is, however, purely classic, though over-lavish and exuberant; in other words, this church façade is painter's architecture.

Palaces. The northern Italian town palaces of the early Renaissance were developed from the medieval Palazzi built around a court, like the Pal. Vecchio at Florence. But the desire for classic symmetry led to plans more systematic and orderly. Court yards were developed with open arcades below, carried on Corinthianesque columns, and window pierced walls above. In exterior design the old massive walling was kept, and the twinned windows; but classic moldings and arches surrounded them, the rustication of the stone was carefully studied, usually from rough below to smooth above, and the whole was crowned by a magnificent classic cornice. Examples are the Riccardi



RUSTICATION IN THE PALAZZO RICCARDI
AT FLORENCE, ITALY

Palace, by Michelozzi; the Strozzi Palace, by Maiano and Cronaca, and the first part of the Pitti Palace, by Brunelleschi, all in Florence; and the Bevilacqua Palace in Bologna.

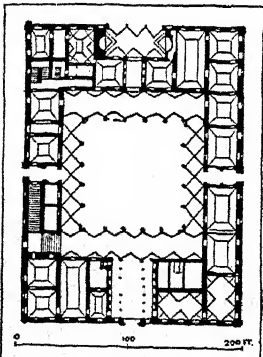
Churches. Though Brunelleschi's two Florentine churches, San Spirito and San Lorenzo, were much like early Christian basilicas, the tendency of the Renaissance was to follow the Pazzi Chapel, and to produce domical and vaulted churches. In this development Alberti's San Andrea, Mantua, was important. Here, for the first time were Roman types of vaulting and Roman details combined with a large dome on pendentives. All sorts of experiments in domical churches were made. Thus BRAMANTE (1444-1514) in Santa Maria delle Grazie in Milan,

about 1480, sought a larger and more monumental expression of the Pazzi Chapel idea, and in Prato the Madonna della Carceri, begun 1495, by Giuliano da San Gallo (1445-1516) used the Greek cross plan, thus giving great emphasis to the dome.



SPANDREL FROM THE LIBRARY OF ST. MARK'S, VENICE

The High Renaissance. The brilliance of the papal court of the early 16th century brought the best architects and artists to Rome, and there, due to changing taste as well as the proximity of great Roman ruins, the next phase, the classicism of the High Renaissance (see CINQUECENTO), was born. Bramante probably visited Rome in 1493, and then designed the Concelleria and Giraud palaces, which, though still preserving some of the earlier delicacy, show in their pilasters, court treatment, with Doric columns, and framed windows, the restraint of the new style. He settled in Rome in 1500, and the balance of his work: Cloister, Santa Maria della Pace; Tempio, San Pietro in Montorio; Court of San Damaso and Belvedere of the Vatican; and first designs for St. Peter's, was all characteristic of the High Renaissance classicism.



A. D. F. HAMLIN, HISTORY OF ARCHITECTURE, LONGMANS, GREEN

PLAN OF THE FARNESE PALACE, ROME

Palaces. The typical High Renaissance Palace somewhat resembled the Florentine examples; but rustication was reduced, and twinned windows yielded to single rectangular or arched windows. Windows and doors were framed with classic architraves or pilasters or engaged columns with entablatures and pediments. Plans were more carefully symmetrical. Interiors used

the orders. Courts often used the Roman arcade, or, at times, the colonnade with flat entablature. The Farnese Palace, Rome, by Antonio da San Gallo the younger (1485-1546), completed by MICHELANGELO (1475-1564) and della Porta (1541-1604) is typical in its monumental grandeur, the comparative simplicity of detail, the vaulted vestibule, and

the magnificent halls. The Massimi Palaces, by B. Peruzzi (1484-1536), show the restraint and refinement of every molding that was the new ideal, replacing the jeweled richness of the earlier century.

Churches. The great dome was still the ideal of church design, and restrained monumental character was taking the place of the Brunelleschi delicacy. Characteristic examples showing the development are the Umlta, at Pistoja, 1509, by Ventura Vitoni; San Biagio, Montepulciano, by Antonio da San Gallo the elder (1455-1534); and the Madonna della Consolazione at Todi, by Cola da Caprarola, begun in 1508. All of this development was summed up and expressed in Bramante's design for St. Peter's, begun in 1506. In this he said his ideal was to place the "dome of the Pantheon on the Basilica of Constantine," a complete expression of the search for great Roman scale and magnificence. After Bramante's death in 1514, his Greek cross plan was worked over and altered by Raphael, Ant. da San Gallo the younger, and others; but in 1546, Michelangelo was appointed architect, and returned to a simplified form of the Bramante idea. The great scale of both interior and exterior orders, about 90 feet high and about 100 feet high, was probably set by Bramante. The present church was still further altered, della Porta and Fontana completing Michelangelo's dome in 1564-1604, and a Baroque nave and an inferior façade being added in 1606 by Carlo Madama, thus spoiling the clarity of the whole. The present church is nearly 600 feet long; the nave span is 83 feet, and the dome spans 140 feet inside. Like Brunelleschi's dome in Florence, the St. Peter's dome is in two shells tied together by stone web ribs; its thrust is taken care of by chains built into the masonry.

Later Developments. In 1440 Alberti had used pilasters on the Rucellai Palace in Florence. The High Renaissance turned more and more to the orders, both decoratively and structurally, as in much work of RAPHAEL (1483-1520) and Giulio Romano (1494-1546); from 1540 on, the orders were more and more important. Thus in the palaces flanking the Capitoline square, designed about that period by Michelangelo, colossal pilasters running through two stories were used, combined with smaller free-standing columns to form loggias. G. B. Vignola (1507-72) used the orders freely in the Villa of Papa Giulio, Rome, and the great Palace of Capracola, but with a delicacy and restraint almost like that of Peruzzi. In Verona, Vicenza and Venice, and in the work of M. Sammichele (1484-1554), J. Sansovino (1477-1570), and later, A. Palladio (1518-80), this development almost entirely controlled the design. The City Gates, the Pompeii and Bevilacqua palaces at Verona, and the Grimani Palace at Venice, all by Sammichele, are characteristically powerful in design; the Cornaro Palace and the Library at Venice by Sansovino show the rich grace of his treatment. Palladio's work in Vicenza depends almost entirely upon the orders for its effect; the variety he obtained

shows his exuberant imagination. Characteristic are the Valmarano, 1556, and Barbarano, 1570, palaces, and the Prefitizzio and the delicate Villa Capra.

The Baroque. All of this insistence upon exterior effect, coupled with a reaction against the occasional academic quality of the High Renaissance led naturally to the Baroque, when architecture was approached from the sculptural rather than the structural angle. Variety and climax dictated plan types as well as exteriors; the magnificent simplicity of the St. Peter's forecourt, by L. Bernini (1598-1680), and the dignity of the Genoese palace courts Durazzo and University, both by Bianchi, are as truly Baroque as the vibrant detail of St. Agnese, Rome, by F. Borromini (1599-1667). Curves in plan and elevation were common. Structural rhythms were developed into exuberant form, as in the church of Santa Maria della Salute in Venice, by B. Longhena (1604-82). At the end of the 17th, and in the 18th century, a new architectural center developed in Turin, the capital of the House of Savoy. There is evidence in its buildings of some rococo influence from France and Austria, and the palaces and the great church of La Superga by F. Juvara (1685-1735) well illustrate the resultant exuberance and lavishness.

Other characteristic Italian Baroque architects with some of their works are: G. Alessi (1500-72), Court of the Marino in Milan, and Palazzo Pallavicini, Genoa; B. Ammanati (1511-92), Court of the Pitti Palace, Florence, and Ducal Palace, Luca; D. Fontana (1543-1607), Fonte Felice, Rome, and Lateran Palace, Rome; C. Maderno, Santa Maria della Vittoria, Rome; C. Rainaldi (1611-91), Façade of San Andrea della Valle, and Piazza del Popolo and its twin churches, Rome; Pozzo, San Ignazio, Rome; M. Lunghi (d. 1591), Borghese Palace, Rome. The east front of St. John Lateran, 1734, by Galilei, and the exterior of Santa Maria Maggiore, 1743, by Fuga, both reveal the vulgar ostentation of effect that 18th century exaggeration of scale sometimes produced.

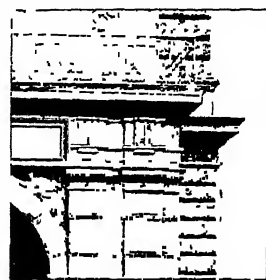
The Renaissance in France. The great expeditions of Louis XII and Francis I into Italy, to support a visionary claim to the throne of Naples, had wide effects. The order, cleanliness and luxury of the Italian cities and the beauty of Italian gardens were a revelation. Not only were Italian objets d'art brought back by the French but also the new Renaissance taste. Louis XII invited Italian artists and artisans to the French court, and Francis I followed his example. Moreover, Francis I was one of the greatest royal builders in history, and his court sought to emulate him. In all this building an effort was made to use classic architectural details and ornament.

The result, the style of Francis I, was a secular style primarily producing palaces and CHATEAUX. It was a style of delicacy and naïveté. Not only did basic structure and plan remain medieval; but even the classic ornament that covered them was rendered in a free way often revealing Gothic tradition. Steep roofs, pierced parapets, windows in vertical tiers framed by pilasters, elaborate chimneys with rich

fireplaces, lavish dormer windows with mullions and transoms, all mark the style. There was much use of candelabrum shaft motives, Corinthianesque capitals, acanthus scroll work, and the salamander and crowned F of Francis I. Planning remained primitive, and churches continued to be Gothic; in St. Eustache, Paris, the Gothic structure was treated with tiers of miniature classic detail. Characteristic buildings are the Francis I wing of Blois, and the Chateaux of Chambord.

At Fontainebleau, several Italians, among others Il Rosso (1496-1541) and Primaticcio (1490-1570), had been brought together by Francis I, and their classic influence, showing in the Gallerie Francois Premier there, began to widen towards the end of the reign, leading to the early classical phase known as the style of Henry II. Its characteristics are shown in

the first wing of the Louvre, by Pierre Lescot (1510-78), the Chateau D'Anet, by Philibert de l'Orme (1515-70), and the same architect's work on the Tuileries in Paris. The classical details were now thoroughly understood by French architects; the Italian influence weakened, and the classic orders were used with grace and correctness to decorate buildings still entirely



RUSTICATION OF A CORNER OF THE LOUVRE, PARIS, IN THE STYLE OF HENRY II

French in their large window areas, and high, richly decorated roofs. Moreover, there was much exquisite architectural figure sculpture, like that of Jean Goujon in the Louvre. Planning became more formal, symmetrical and studied, and the Gothic disappeared even in church design.

Under Henry IV, Baroque influence predominated; boldly projecting carving replaced the earlier delicacy. Broken pediments, heavy garlands and extravagant cartouches decorated doorways, window tops and fireplaces. An impetus towards free invention conflicted with a counter influence towards classicism. The result was a period of comparative chaos. Characteristic was the development of a free type of brick and stone, or stone and stucco architecture, using quoins and panels, but not the orders, as in the Place Royale (now Place des Vosges), the service court of Fontainebleau, or the later Chateau of Bailleroy by Francois Mansart (1598-1666). Equally characteristic are the heavy-handed orders and pediments of the Grande Gallerie of the Louvre, by L. Metezeau or J. B. du Cerceau, about 1595. In the reign of Louis XIII, under the influence of Cardinal Richelieu and Francois Mansart, this conflict approached solution; exteriors, as in the Chateau of Maisons, by F. Mansart, becoming more and more classic; interiors more and more free. In church architecture, the Jesuit influence of Rome was dominant, for example, Sorbonne Chapel, by J. Lemercier (1585-1654), and Val de Grace, by F. Mansart and others.

Under Louis XIV the classic ideal, expressed with monumental grandeur and great symmetry of planning, was supreme. Thus Bernini's Baroque design for the completion of the Louvre was refused in favor of the restrained classic scheme of Dr. Claude Perrault (1613-88). Columns, pilasters, balustrades, flat roofs, delicate rustication, were more and more used. Great schemes of civic embellishment, as for example, Place Vendôme, Paris, by J. H. Mansart (1645-1708), were initiated. City houses (hotels) were symmetrically planned, often with a forecourt between service wings, and the main residence at the rear overlooking both court and a garden behind. Stairs were featured. In domestic interior work, wood paneling became common, sometimes with multiple moldings, sometimes broken by pilasters; a rich classic cornice crowned the wall, and the ceiling was deeply coved and richly modeled. White and gold became the standard colors, and mirrors were used lavishly, especially over fireplaces. The Louis XIV additions to Versailles, the exteriors by J. H. Mansart, and the interiors under the direction of Charles Le Brun (1619-90), are characteristic. Notable houses are the Hotel de Beauvais, by A. le Pautre, and the Hotel Lambert, by Louis Leveau (1612-70). In church design French architects sought either Renaissance expressions of national forms, as in St. Sulpice, Paris, by Louis Leveau, a cross-shaped structure of Gothic plan; or else new types of domical schemes, as in the Chapel of the Institute de France, by Leveau, or the magnificent Dome of the Invalides, Paris, by J. H. Mansart.

Under Louis XV exteriors, still classic, became daintier and more refined; but in the carving there were occasional hints of the rococo that ruled the interiors. Iron balconies were much used. City house plans became more compact, intimate and livable, with services carefully studied. Oval and circular rooms were freely and ingeniously used. The city of Nancy is full of characteristic Louis XV work, particularly in the lovely group of the Place Stanislas, the Carrière, etc., by Héré de Corny, about 1750, with restrained classic buildings and rich iron work. In interiors, the decorator's fancy ran riot; the orders disappeared; moldings became soft in contour. Corners of panels were cut off by foliated C-curves, and right angles avoided. Realistic carving of flowers and leaves and ribbons was lavishly used, and shell forms were common. Curves were sought everywhere, and often even panels were unsymmetrical. Playful painting, *singerie*, *chinoiserie*, and pastorals decorated panels and overdoors. Characteristic examples of Louis XV work are the Hotel d'Amelot, Paris, by G. Boffrand (1667-1754); parts of the Hotel Soubise, by Boffrand (Musée des Archives), and the Galerie dorée of the Hotel de Toulouse (now Banque de France), Paris, by Robert de Cotte (1665-1735).

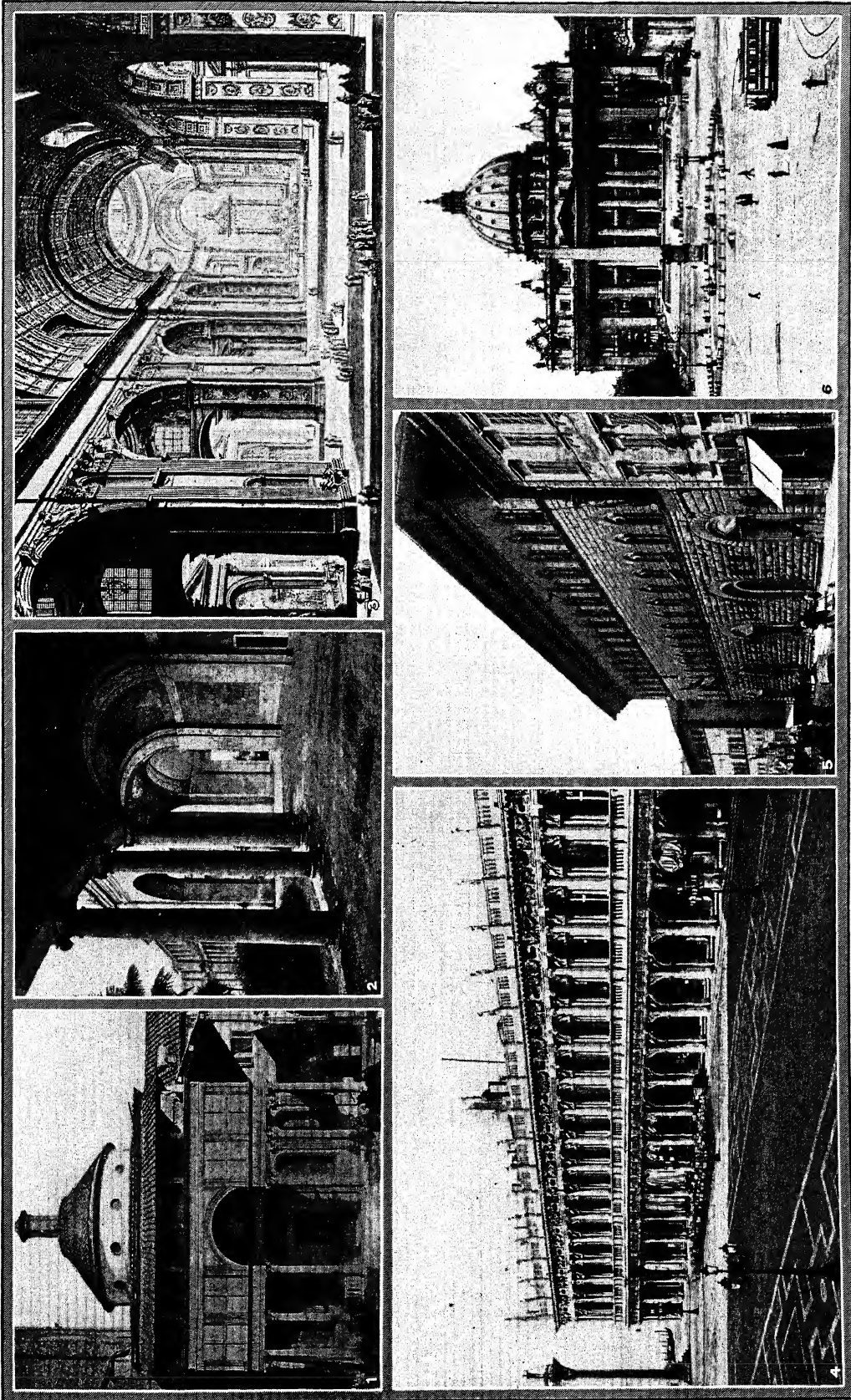
In the succeeding reign there came a violent reaction into classicism. Columns and porticoes became common. Interiors returned to simple right angles and delicate classic decoration. A desire to ape Ro-

man work, prophetic of the Empire (*see* MODERN ARCHITECTURE) appeared. Houses were made one story high, as for example, Hotel de Salm, now Palace of the Legion of Honor, by P. Rousseau, about 1785. Even in church design this Romanism appeared in the front of St. Sulpice, by Servandoni (1695-1766), with its Roman arcades, and especially in the Panthéon (once the church of St. Genéviève by Soufflot (1709-80), a tour de force of scientific dome construction as much as of classicism. Its unpierced walls and pedimented portico reveal the effort to attain Roman dignity. Other important public works of the period are the Place de la Concorde in Paris, with its two flanking buildings, by J. A. Gabriel (1698-1782); the Petit Trianon, at Versailles, by J. A. Gabriel, built during the last years of Louis XV, but fully in the later style; the theater at Bordeaux, 1753-80, by V. Louis; the mint in Paris, by J. D. Antoine, 1770; the École de Médecine, by Gondouin, 1774; and the great court of the Palais Royale, by V. Louis, 1784.

The Renaissance in Germany. The classic forms of the Renaissance percolated but slowly into Germany, despite occasional work by traveling Italian artists in the east, as for example, The Belvedere at Prague, 1536, by P. della Stella, and were at first used merely as surface decorations on forms still purely medieval. Thus pilasters or gâines were used on the vertical members of half-timber houses. The banked windows, high gabled roofs and rich dormers characteristic of the Germanic late Gothic town were retained even in masonry building where the detail was entirely classic and Baroque, as in the Peller House at Nuremberg, 1605. Castles and palaces of this period were picturesque, with broken outlines and crowded detail. In some, the ornament was more sophisticated, as in the Schloss at Brieg, 1552, where the strange mixture of delicate classic and grotesque sculpture in the doorway is noteworthy, and in the Otto-Heinrichs Bau, 1554, and the Friedrichsbau, 1601, of Heidelberg castle. Germanic taste welcomed Baroque forms, using finials, C-scrolls and curved pediments, and working out new forms of its own, especially strap-work, or flat geometric carving in two planes combined with projecting jewels, and curved scroll ends. Many German town halls are among the most beautiful examples of the style, especially the loggia of the Cologne Town Hall, and the rich, simply composed, and delicate Rathaus at Bremen, 1609. Interesting houses can be seen at Nuremberg, Rothenburg and Frankfurt am Main.

The Thirty Years' War was a decisive break between this transitional Renaissance and the Baroque that followed it. Properly speaking, there is no High Renaissance in Germany. The growing power of Austria and Prussia after the war is seen in the entirely sophisticated Baroque buildings in Berlin, Salzburg, Munich and Vienna; in all of these of the 17th century Italian influence is dominant. Typical examples are the Royal Palace, Berlin, by Schlüter, 1700; Cathedral at Salzburg, by Scamozzi and Solari, 1614-34, and Theatine Church, Munich, 1670, by

RENAISSANCE ARCHITECTURE

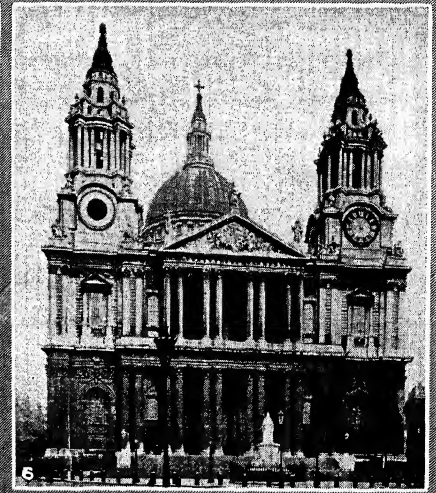
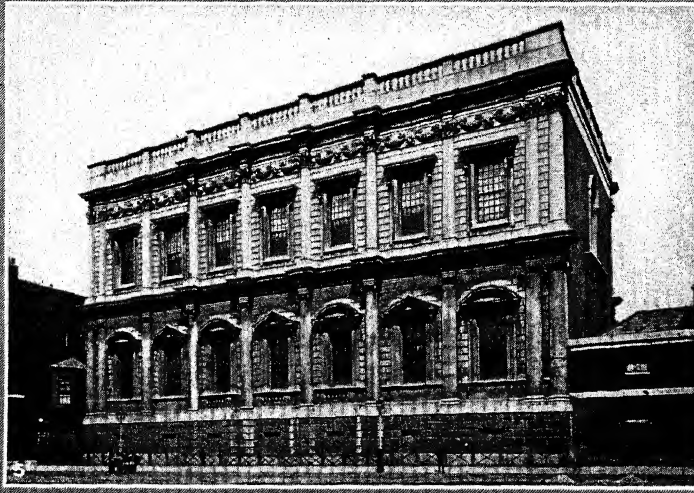
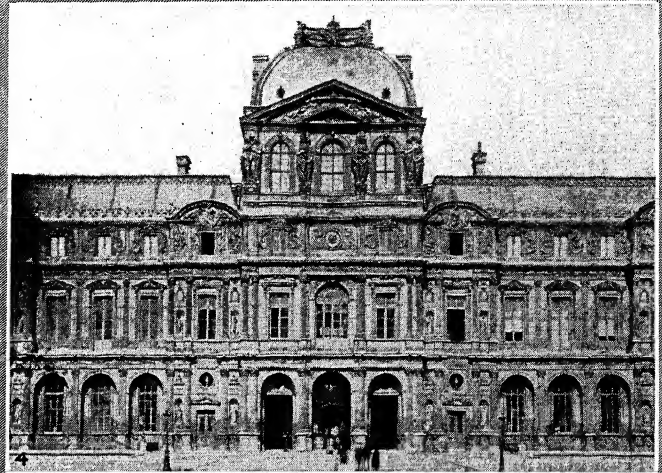
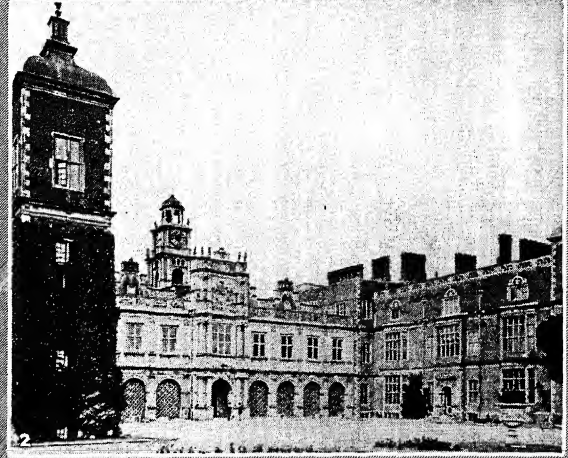
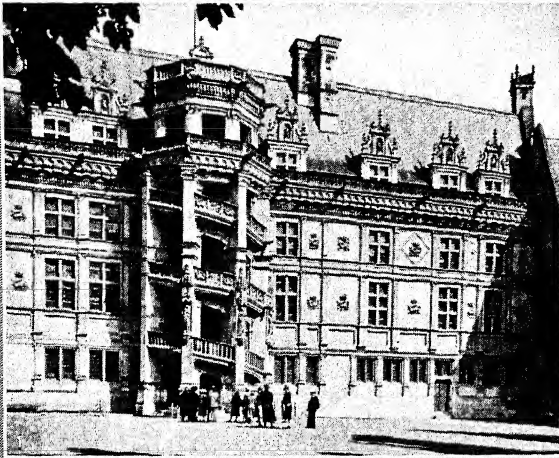


3, FROM AN ENGRAVING BY GIOVANNI BATTISTA PIRANESI; 5, EWING GALLOWAY PHOTO

RENAISSANCE ARCHITECTURE IN ITALY

1. Capella dei Pazzi, Church of Santa Croce, Florence. 1430. Brunelleschi, Architect.
2. Vaulted archway of the Villa di Papa Giulio, Rome. 1550-55. Vignola, Architect.
3. Interior of St. Peter's (San Pietro in Vaticano), Rome. 326. Bramante, Michelangelo and Maderna, Architects.
4. Old Library, Venice. 1536-53. J. Sansovino, Architect.
5. Palazzo Medici (Riccardi), Florence. 1442-52. Michelozzo, Architect.
6. Piazza and St. Peters, Rome. Maderna, Architect of the façade.

RENAISSANCE ARCHITECTURE



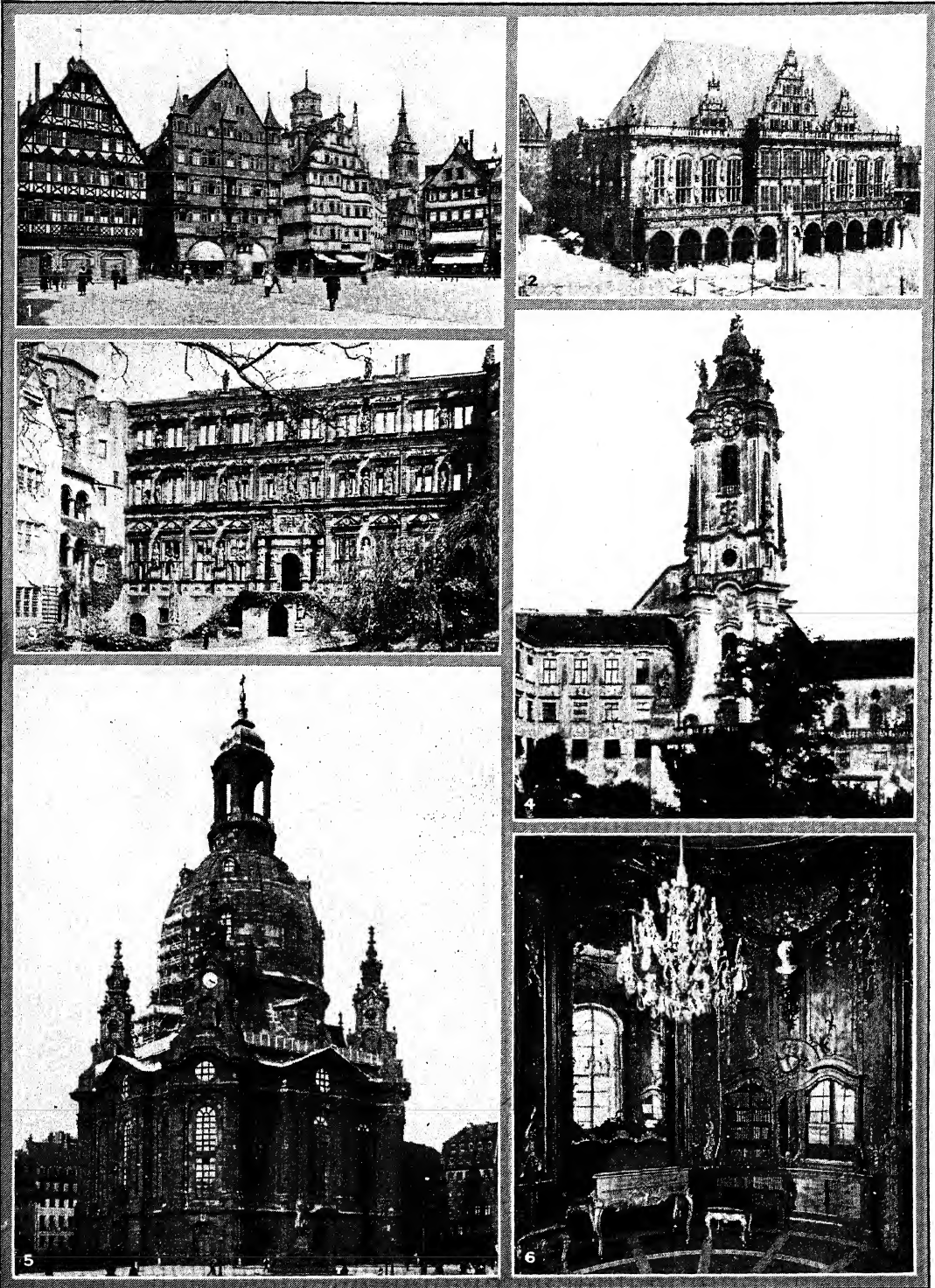
1, DE COU PHOTO, FROM EWING GALLOWAY; 3, EWING GALLOWAY PHOTO

RENAISSANCE ARCHITECTURE IN ENGLAND AND FRANCE

1. Newel staircase in the open octagonal tower of the Chateau at Blois, France. Late 15th century. 2. Hatfield House, Hatfield, England, a Jacobean mansion built about 1611. 3. Dome of the Invalides, Paris. 1670-75. J. H. Mansart, Architect. 4. Façade of the Pavillon de l'Horloge,

Louvre, Paris. Early 17th century. Jacques Lemercier, Architect. 5. Banqueting House, Whitehall, London. 1619-22. Inigo Jones, Architect. 6. Facade of St. Paul's Cathedral, London, a characteristic English Renaissance building. 1675-1710. Sir Christopher Wren, Architect.

RENAISSANCE ARCHITECTURE



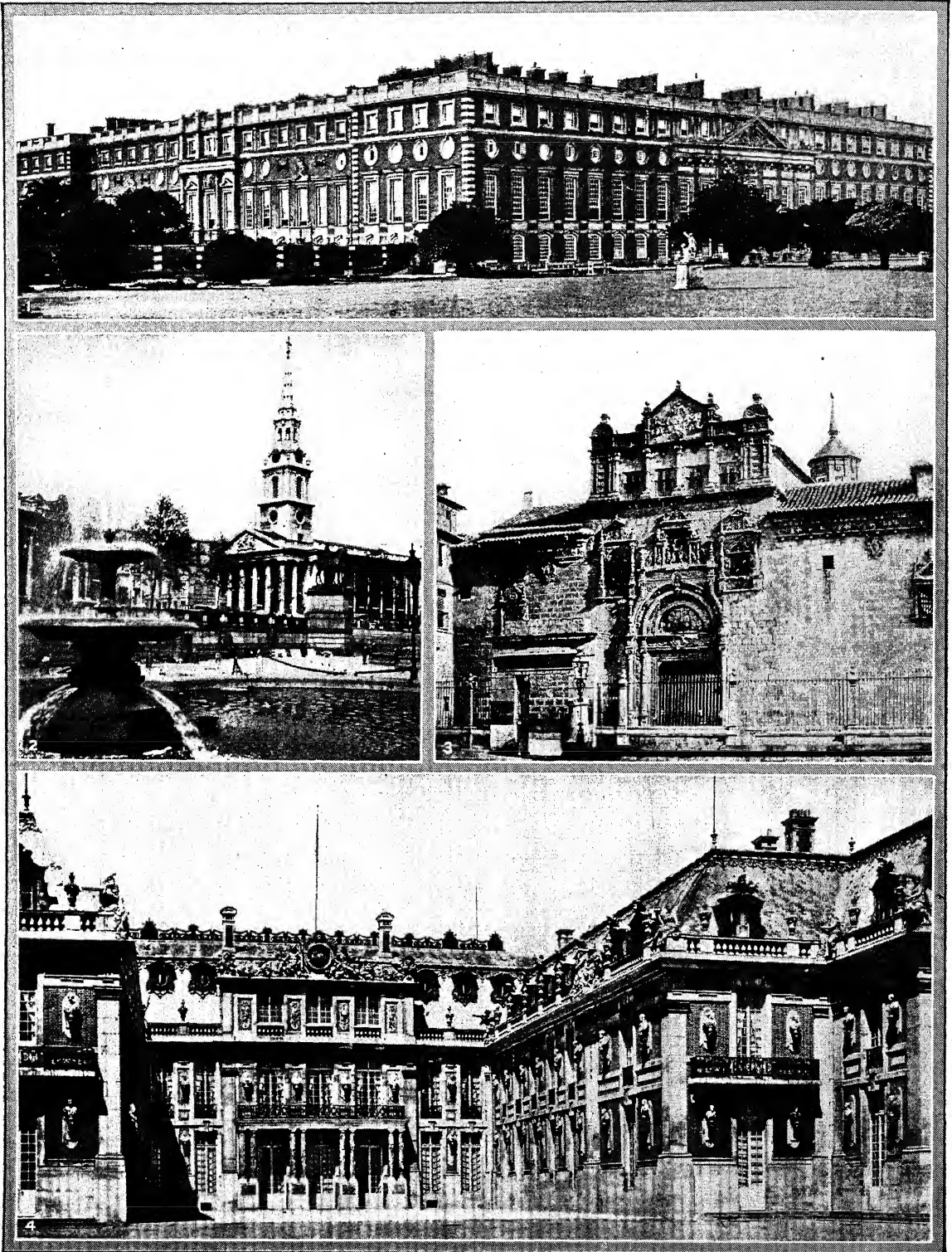
1, 6. COURTESY GERMAN TOURIST INFORMATION OFFICE; 4. BY BURTON HOLMES, FROM EWING GALLOWAY; 5. EWING GALLOWAY PHOTO

AUSTRIAN AND GERMAN ARCHITECTURE

1. Buildings fronting the marketplace, Stuttgart, Germany, generally 17th century. 2. Rathaus, or Town Hall, Bremen, Germany, 16th-early 17th century. 3. Façade, adorned with sculptured figures, of the Otto-Heinrichs-Bau, begun in 1556, part of the old Heidelberg Castle. This sculptured

decoration, symbolical in meaning, is typical of the Renaissance. 4. Monastery at Dürnstein, Austria. J. Prantaver, Architect. 5. Frauenkirche, The Church of Our Lady, Dresden. G. Bähr, Architect. 6. Rococo library of the Palace of Sanssouci, Frederick the Great's Castle at Potsdam.

RENAISSANCE ARCHITECTURE

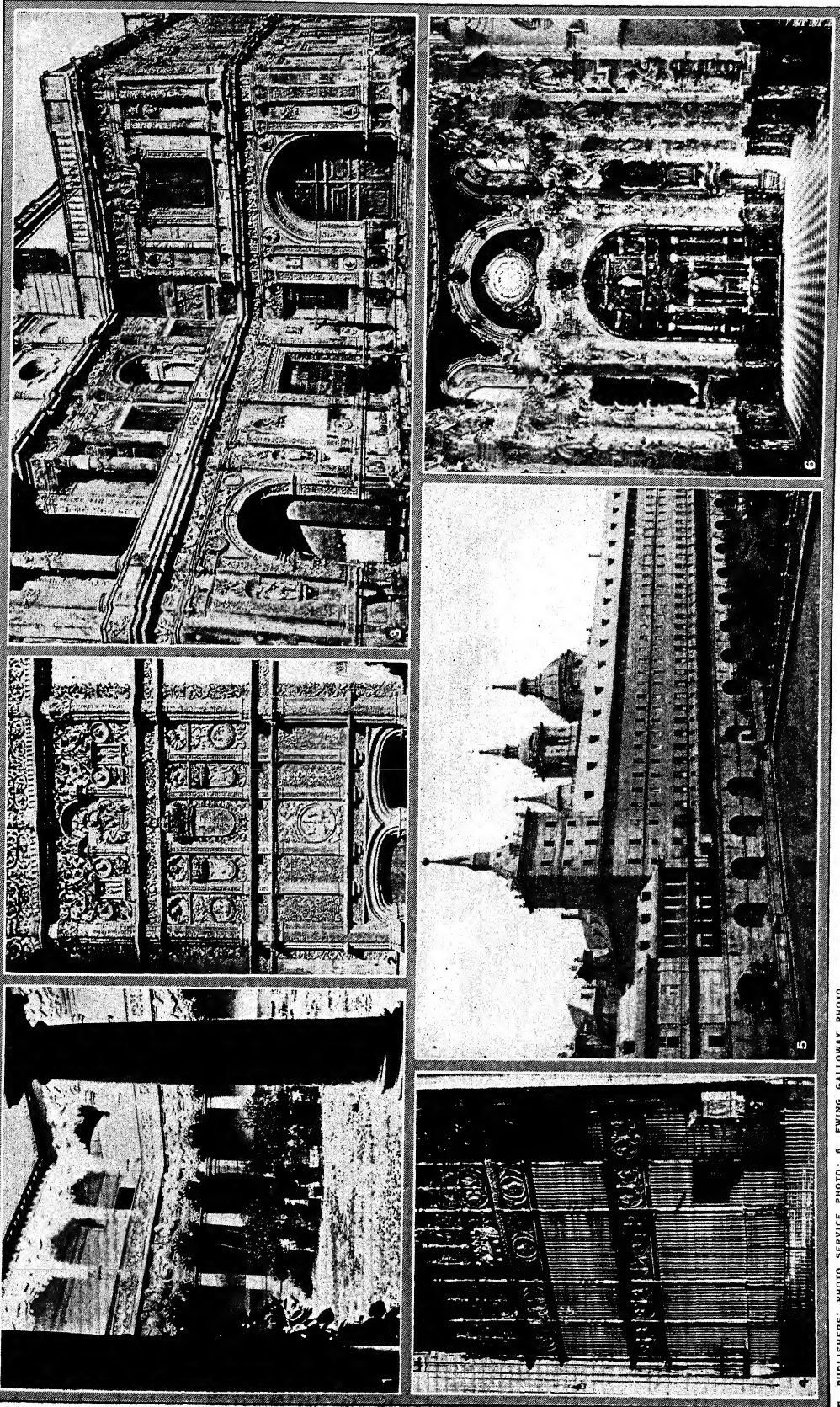


RENAISSANCE ARCHITECTURE IN ENGLAND, FRANCE AND SPAIN

1. Hampton Court Palace, in the environs of London. Sir Christopher Wren, Architect. 2. Trafalgar Square, London, with St. Martin's-in-the-Fields, erected 1722-26, in the background. Sir James Gibbs, Architect. 3. The Hospital

of Santa Cruz, Toledo, Spain. 16th century. 4. The Cour de Marbre of the Palace of Versailles, France, dating from about 1624-26. Salomon DeBrosse, Louis Leveau and J. H. Mansart were the architects of the great Château.

RENAISSANCE ARCHITECTURE



5. PUBLISHERS' PHOTO SERVICE PHOTO; 6. EWING GALLOWAY PHOTO

MONUMENTS OF SPANISH ARCHITECTURE OF THE PAST

1. Courtyard of the Palace of the Duques del Infantado, Guadalajara, 1461. 2. Detail of the upper part of the west facade of the University of Salamanca, early 16th century plateresque style. 3. The Ayuntamiento, or City Hall, Seville, built 1527-64, Spanish Renaissance architecture. 4. Detail of the Renaissance reja (iron screen) of the high altar, Cathedral of Seville. 5. The Escorial in the Guadarrama Mountains northwest of Madrid. Built by Philip II in 1559-84, it is a leading example of the Greco-Romano period of Spanish Renaissance architecture and one of the largest buildings in the world. 6. Sacristy of La Cartuja, Granada, Churrigueresque style.

Barelli. The Austrian architects, Fischer Von Erlach (1560-1723), who published a history of architecture, Lukas Von Hildebrand (1668-1745), and Jakob Prandtauer (1658-1726) all studied Italian work. Their version of the Baroque was, however, their own; it was distinguished by great scale, great contrast between severity of conception and lavishness of detail or vice versa, a masterly use of curves in plan, as seen in Hofbibliothek, Vienna, and Karlskirche, Vienna, both by Von Erlach, and Belvedere Palace, Vienna, by Hildebrand, and by strong architectonic sense. The monasteries of Prandtauer, especially Durnstein and Melk, show the typical monumentality, dignity, lavishness, broken lines and restless detail. Further north, the Frauenkirche at Dresden, by Bahr, reveals the same search; no church in Europe has made its dome, early 18th century, so stunning a climax.

In the 18th century, the pervasive influence of the court of Louis XIV is shown in an increasing amount of French rococo influence. Thus the work at Potsdam, as for example, Sanssouci, by Knobelsdorf, 1745, is essentially French in type, and the Residenz at Wurzburg, by J. B. Neumann, about 1730, is typical of the attempt of the German princes to build each one his own miniature Versailles. In Bavaria, the French Cuvillies family designed many churches and palaces; the delicate rococo of the Amalien Nymphenburg, Munich, 1734-39, is typical. Other architects attempted to use on the exterior the same type of rococo detail which the French had reserved for interiors. The Assam house, Munich, by the Brothers Assam, is characteristic, as is the delightful court of the Zwinger Palace in Dresden, by Poppelmann. In interiors, there was throughout the period a mixture of the monumental Baroque of Italy and the rococo of France, together with an undue use of atlantes, cupids and figure sculpture generally. Despite their unparalleled lavishness, even in churches, these interiors were less successful than the exteriors.

Renaissance in Spain and Portugal. Italian sculptors were working in Spain at the beginning of the 16th century, and the Italian ambitions of Charles V naturally created a growing demand for Italianesque and Renaissance forms. But in Spain there was a vivid Moorish and late Gothic tradition, and when Spanish architects learned the classic details, they were not used in the Italian way, but as surface ornament, much as the Moorish interlaces on the Alhambra had been used. This early Renaissance style was called Plateresque, from its resemblance to silversmith's work. Its characteristics were the use of ornament to frame doors and windows only, leaving large areas of plain wall, as seen in the Hospital of Santa Cruz, Toledo, by Enrique de Egas, 1504-14; the development of the door frame into a great composition running the whole height of the wall, as found in the University door, Salamanca, about 1530; the persistence of the Moorish use of tiles as wall wainscoting, especially in Seville, and of the elaborate wooden ceilings called *artesonados*, as seen in the Palace at Peña-

randa, about 1530; the use of masques, figures, grotesques or animals where the Italian would use foliage, the use of much beautiful iron work (*rejería*) in which turned verticals were artfully composed with rich crests; and the development of beautiful and characteristic cloisters and house courts, usually in two stories, with freely treated columns, sometimes of baluster shape, interesting bracketed capitals, and rich openwork railings, as seen in the Archbishop's Palace, Alcala de Henares, by Covarrubias, about 1530. Other characteristic examples of the style are the Irish College, Salamanca, by Covarrubias and P. Ibarra, about 1530-50, and the wonderful screen and tombs in the Royal Chapel at Granada.

Meanwhile, under the influence of Charles V, a more classic taste was developing, showing especially in the town hall of Seville, by Diego de Riaño, about 1527, and Granada Cathedral, by Diego de Siloe, 1525-63, where, although the spirit was still Plateresque, the details were more correct. This growing classicism culminated in the short-lived Griego-Romano style under Charles V and Philip II. It produced two masterpieces, the unfinished palace of Charles V at Granada by P. Machuca, begun in 1526, with a magnificent circular peristyle court, and the enormous pile of the Escorial, a combined palace and monastery, 675 feet by 530 feet, by Juan Bautista and Juan de Herrera, 1560-84. This last, in plan, dignity and simplicity, was one of the greatest architectural conceptions of the entire Renaissance, and its almost cliff-like austerity was well suited to the character of the grim Philip II, and harmonized with its rugged bleak surroundings. The garden court of the Evangelists is particularly lovely in proportion and detail.

But the lavishness of the Baroque was more congenial to the Spanish temperament than classicism. Introduced into Spain by the Italian Crescenzi, 1630-60, Baroque forms soon spread over all the peninsula, and received an even more bizarre treatment than in Italy itself. Under J. Churriguera (d. 1725) and his followers a peculiar style known as Churrigueresque arose that reigned from about 1680 to about 1750, in which even the most remote resemblance to classic forms sometimes disappeared entirely, as in the Sacristy of La Carteya, Granada, where every break is encrusted with broken moldings, scrolls, little pieces of broken pediments and foliage. In some Madrid examples the detail is merely a dramatic flourish without architectural significance. Altars and altar pieces are fantastically rich in gold and color as well as in form; occasional church façades, often with a niche-like treatment, achieve monumental dignity, as for example, the Cathedral at Murcia, 1715, by J. Bort. Towards the end of the 18th century foreign influence from France and Italy (Juvara designed the palace at Madrid) prevailed over the native tradition; but in the Spanish colonies of North and South America, local versions of the Churrigueresque were popular until well into the 19th century. Mexican versions are especially rich. Portuguese architecture tended to parallel Spanish developments, though Gothic influence was stronger

in the earlier examples, as typified by the convent at Thomar, by Castilho, about 1525. The more classic types can be seen in the Marvilla church at Santarem, about 1580, and the cathedral cloister at Vizeu. The latter Baroque is illustrated in the great palace and monastery at Mafra, begun in 1717 by a German, Ludwig, and the 18th century palace at Braga.

Renaissance in Holland and Flanders. The Renaissance developed late in the low countries, and three influences are recognizable in it, Italian, Spanish and German. The first is shown in a generally correct use of the orders, as in the town hall of Antwerp, by de Vriendt and perhaps Floris, 1561; the second in a love for bizarre and Baroque effects; and the third in the persistence of high roofs, rich stepped and scrolled dormers, and a profusion of strap work. The churches of Belgium usually followed Italian Jesuit models, as in St. Michael's at Louvain, 1550-66, or St. Charles Borromeo at Antwerp. Secular buildings, more Teutonic in type, often achieved notable charm in their close-ranked windows and delicate Baroque details, as in the Guild houses on the Grande Place at Brussels. In Holland, where Spain was hated, the German influence was stronger; moreover, the rarity of stone and the necessity of building in brick produced still greater changes from the usual classic types. The charming, if naive, effects thus produced are well illustrated in the Town Hall at Bolswaert, 1614. Later, numerous attempts at a more Palladian classic are found, as in the Mauritshuis at The Hague, by von Campen, 1633-44; but the chief charm of Dutch architecture continued to be in the delightful use of exterior brick, and interior tiles, in simple and naive ways.

Renaissance in England. Despite the fact that Pietro Torregiano (1472-1522) carved the purely Italian tomb of Henry VII at Westminster in about 1512, and that other Italians worked in England, the English Renaissance developed slowly. In the many manor houses built in the 16th and early 17th centuries generally Gothic Tudor elements (*see* **TUDOR STYLE**) continued in use, such as mullioned windows, the great medieval hall, many gables, developed chimneys and the Tudor arch. Italian influence was limited to details, like the Caesar reliefs in Hampton Court Palace, or the beautiful classic choir screen of King's College Chapel, Cambridge, or the panels in Layer Marney, about 1520. Under Elizabeth (1558-1603), however, the classic influence increased. Orders on the exterior, flat roofs and balustrades, were used, and symmetrical plans superseded earlier informality, as for example, the Longleat House, by John of Padua, 1550-80. At the same time, two English architects, Robert Smithson and John Thorpe, began designing large houses; Wollston Hall, 1580, by Smithson, and Kirby Hall, 1575, by Thorpe, show the naive caricatures of the orders, the persistence of mullioned windows and bays, and the search for an often forced symmetry, characteristic of the style. Other important houses are Hardwicke Hall, with enormous windows, and Burghley, whose chimneys

treated like columns bearing entablatures show the desire to use the orders as a sort of elegant curiosity. A more sophisticated example is Hatfield House (1611), whose rich entrance shows the Baroque tendencies that became popular in the 17th century through Flemish and German influence. Theodor Have is an early example of a Fleming architect in England; to him is due the miniature Gate of Caius College, Cambridge, with its parade of fairly correct orders. Interiors of this time were richer; pilasters broke up the paneling, cornices crowned it; L-shaped panels surrounding a square were used, mantel pieces became larger and more elaborate, with gables, strap-work, niches and crude sculpture, and ceilings were elaborately decorated with geometric patterns of interlacing moldings and foliage. The hall lost its importance, its screen and its dais, and finally became a mere entrance way or passage.

INIGO JONES (1572-1652) put an end to this transitional work. At first a designer of court masques, he later traveled in Italy, and was made Royal architect by James I. He became a disciple of Palladio, and his Italianate classicism is shown in the Banqueting Hall, Whitehall, 1622; the only part of a vast palace scheme, showing also French influence, to be constructed. To him or his pupil Webb is attributed also the classic Strand Water Gate; and both started the great Greenwich Palace, later changed to Greenwich Hospital. In the houses attributed to him, such as Coleshill, 1650, compact rectangular plans are found, and pure classicism of detail, without Jacobean modifications. To his work may be traced the tradition of the smaller English country house that continued to develop for a century, with brick walls, stone trim, classic cornice, hipped roofs, large simple chimneys and a delicately Baroque central entrance.

Following the Commonwealth, the court of Charles II was entirely classic in taste, and the great fire of London, 1666, with the rebuilding it required, solidified the classic tradition. It also brought to the fore CHRISTOPHER WREN (1632-1723), who, in dozens of new churches, and finally in St. Paul's Cathedral, 1675-1710, used free creative versions of classic Renaissance detail. The churches were extraordinary in producing monumental interiors with a minimum of expense and space, as seen in St. Stephen's, Wallbrook, and because in their towers, as in Bow Church, Wren achieved a combination of spires, Baroque lanterns, and simple substructure that crystallized into the typical Georgian white steeple typified by St. Martins in the Fields, London, by James Gibbs, 1683-1754, and so was the ancestor of countless charming American examples. St. Paul's ranks as one of the greatest domical churches in Europe. Its dome, 108-foot span, covers an octagon the entire width of nave and aisles, thus producing immense spaciousness. It is a three-shell dome; an inner dome, a brick cone with domed top supporting a stone lantern, and an outer shell of timber and lead; structurally it is a masterpiece, and its exterior effect is superb.

Wren's followers were completely given to the mon-

umental, Palladian ideal. Manor houses became monuments rather than dwellings; ostentation replaced charm. The work of Van Brugh (1664-1726), Blenheim, or Castle Howard, was superbly planned, but theatrical in effect; that of James Gibbs, St. Martins in the Fields, London, Radcliffe Library, Oxford, with its lovely dome, was more restrained, though equally classic. Colin Campbell's Wanstead House, about 1720, shows the extreme of classic dignity achieved. Smaller houses, however, still retained the quiet charm of the earlier manner of Jones and Wren, as for example, the Houses on the Close, Salisbury, and many in London suburbs, as Richmond and Hampstead.

During the remainder of the 18th century, the development of classicism split. One school, following Sir William Chambers (1726-96), whose greatest work was Somerset House, London, continued in the Italian Renaissance tradition; the other turned more and more to ancient Roman models. Thus in the work of the two George Dancees (1695-1768, 1741-1825), Mansion House, Fleet Street Prison, monumental pedimented porticoes and heavy Roman scale are found. Paine sought more refinement, and the movement culminated in the very Roman and monumental work of ROBERT ADAM (1727-92), as found in Keddlestone Hall, University of Edinburgh, Syon House, Adelphi Terrace, London, and other buildings, whose creativeness prevented mere archaeological copying, and working on the Roman detail, produced the delicate yet bold style of ornament called by his name.

T. F. H.

BIBLIOGRAPHY.—General M. S. Briggs, *Baroque Architecture*, 1913, F. M. Simpson, *A History of Architectural Development*, Vol. III, 1916, G. Scott, *The Architecture of Humanism*, rev. ed., 1924. For Italy H. Geymuller and A. Widman, *Die Architektur der Renaissance in Toscana*, 1885-1908, J. Durm, *Bankunst der Renaissance in Italien*, 1914, C. Ricci, *Architecture and Decorative Sculpture of the High and Late Renaissance* (Eng. trans.), 1923, and *Baroque Architecture and Sculpture in Italy* (Eng. trans.), 1912; W. J. Anderson, *The Architecture of the Renaissance in Italy*, rev. ed., 1927. For Spain A. Prentice, *Renaissance Architecture and Ornament in Spain*, 1890, A. Schubert, *Der Barock in Spanien*, 1908, A. Byne and M. Stapley, *Spanish Architecture of the XVI Century*, 1917; A. Whittlesey, *Architecture of Southern Spain*, 1922; *Architecture of Northern Spain*, 1922. For Germany A. Ortwien and A. Scheffer, *Deutsche Renaissance*, 1871-88; W. Lubke, *Geschichte der Renaissance in Deutschland*, 1911, K. Horst, *Der Architecture der Deutschen Renaissance*, 1928. For France W. H. Ward, *Architecture of the Renaissance in France*, 1911; Sir R. Blomfield, *A History of French Architecture*, 1494-1661, 1912; *A History of French Architecture*, 1661-1774, 1921; C. Martin, *La Renaissance en France*, 1909-21. For England & America, Sir R. Blomfield, *History of Renaissance Architecture in England*, 1897; Belcher and Macartney, *Later Renaissance Architecture in England*, 1897; J. A. Gotch, *Renaissance Architecture in England*, 1894; F. Kimball, *Domestic Architecture of the American Colonies and the Early Republic*, 1922; T. F. Hamlin, *The American Spirit in Architecture* (Vol. 13 of the Pageant of America), 1926.

RENAISSANCE ART. In the accepted meaning of the term, Renaissance art applies to the artistic impulse of the great intellectual movement intervening between medieval and modern times, involving all Europe, covering the 14th, 15th and 16th centuries. It was through the painting of Italy, where

the movement took its rise, that the Renaissance reached its highest and most characteristic development, and to this the subject will be primarily confined in this article. As an expression of the evolutionary spirit of civilization, Renaissance art was the periodic flowering of the Christian era, in which the spirit of GREEK ART was resuscitated, with the splendor of the inner added to the loveliness of the outer world; a difference between consciousness and consciousness of self; an endowment of humanity with new reflective powers, which complicates that which was simple in Greek life. The task of Renaissance art was to give form to Christian ideas and embody a class of emotions unknown to the ancients, and to retrieve the evil consequences of ecclesiastical orthodoxy, in their forcing of art to render intellectual abstractions by figured symbolism. It was due to the extraordinary ability of sculptors and painters to synthesize these elements that gave to Italian art its astonishing vitality. The human body had ceased to have a value in and for itself. It must be the interpreter of that behind the external form to which it owed its beauty. A more elastic medium than Greek sculpture was needed to express the fugitive play of feature, indicative of internal movement and depths of consciousness, and this it was able to do through painting.

In its initial stages the Renaissance owed little to antiquity. Its roots lay deep in the past, but its flowering came with a sudden brilliance from the germ of Byzantine tradition and French Gothic naturalism. While the rediscovery of antique culture was a decisive factor in giving the Renaissance its bent, it was not its source, and much of its essential characteristics had little to do with it. A great undercurrent of force was at work. All Europe was seething with pent-up energy seeking outlet through every possible channel.

The history of Renaissance Italian painting centers round the art traditions of Florence, Rome and Venice. With the heightening of aspiration through the new art centers or "schools" sprang up throughout Italy. The more important of these, with their distinctive traits, may be found under their names, which included the Florentine, Siennese, Bolognese, Ferrarese, Umbrian, Venetian, Lombardian and Roman. These gradually aligned themselves with one of chief centers. It was in Florence, the longest lived and most steadily progressive, that the first stirrings of the new order was felt, and from here came the two chief precursors of Renaissance art: DANTE in literature and Giotto di Bondone (1276?-1337?) in painting. In his rapid discovery of decorative painting and the depicting of life in the narrative form, Giotto laid the foundation on which the structure of Renaissance painting arose. In its beginnings the Florentine school was instructed by the Siennese, and when that school spent itself in a last blossoming of the Byzantine tradition it gave to the more vital and intellectual Florentines the essence of its life of mysticism. While the influence of Giotto lasted until the

end of the 14th century, his followers were unable to understand his greatness and marked time in gaining technical facility. The art of FRA ANGELICO (1387-1455), suggestive of the finest spirit of medieval mysticism, is a connecting link between the 14th and 15th centuries and the art of Giotto and Tomaso Guidi Masaccio (1401-28). About 1400 there was a sudden inrush of antique culture fostered by the Medicis (see MEDICI, LORENZO DEI). A fresh stage of energy was directed to study of Greek and Latin manuscripts, and collections were made of statues and coins. The Italians, feeling themselves to be the heirs of ancient Rome, sought to emulate the manners of the ancients. Christian and pagan traditions became strangely intermingled in the effort to reconcile the body and soul, and create a world in which heaven was brought down to earth, and earth itself became heavenly. Religious faith gave way to enjoyment of life, unrestrained by medieval piety. The confusion was added to, which has been brought down to the present, by a school of Christian humanists intent on fitting the larger conception of Christianity into Greek philosophy, and by so doing widened the chasm between religion, art, and science.

The 15th century was one of prodigious curiosity, with an increasing craving for perfection. There was an astonishing high average of excellence among the painters, each standing on his own merit and making his individual contribution. Mention can only be made of those whose work marked a change. Masaccio in his brief career marked a definite break with hieratic tradition through his knowledge of anatomy in depicting naturalistic form, and in his understanding of perspective and composition. FRA FILIPPO LIPPI (1406-69) set the example of painting his madonnas from life wherever he saw a beautiful face full of the joy of living. SANDRO BOTTICELLI (1444-1510) was the first to mingle his virgins and venuses, Christian and pagan gods. He breathes the sophisticated spirit that crept into Renaissance in the remaking of ancient deities in the modern spirit. The restraint behind the Greek line was replaced by the highly wrought sensibility of intensified curves and angles. The greatest Florentine, the incarnation and most complete expression of the Renaissance, was LEONARDO DA VINCI (1452-1519), painter, sculptor, architect, poet, mathematician and scientist.

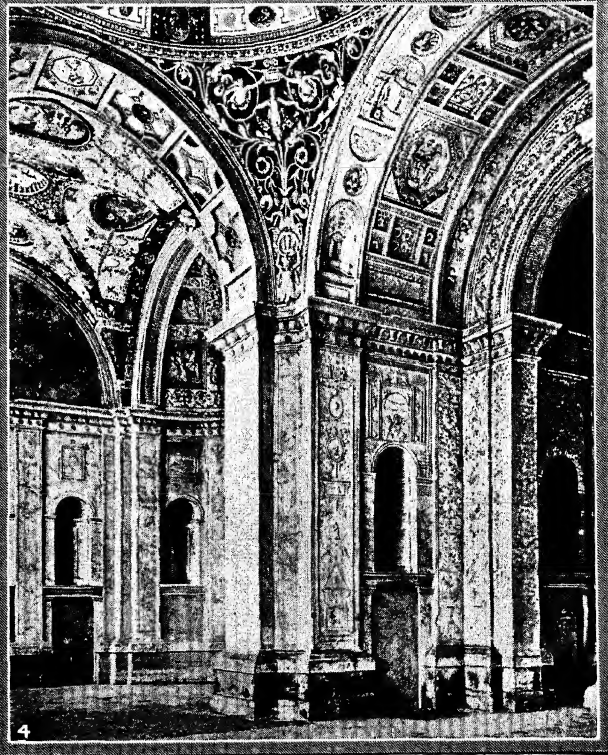
At Rome the Italian Renaissance had its efflorescence during the first half of the 16th century in the works of RAPHAEL SANZIO (1483-1520) and MICHELANGELO (1475-1564). Equipped with the absolute science of two centuries of intense research and experiment in solving the fundamental principles of plastic technique, the work of these two masters was the synthesis of the Renaissance. The superlative skill and harmonious composition of Raphael express his yielding to the unfulfilled purpose of the Renaissance without being galled by it, while the basic quality of power in Michelangelo's work was the antithesis, a power born of great flashes of spiritual insight, but not sufficiently sustained as to enable him to breathe into the

accentuation of muscular contours other than quivering stress and struggle.

Venice, isolated and half-Oriental, had used her portion of the outpouring of Renaissance force in becoming the worldly minded and materially successful member of the Italian states, so that when she turned her attention seriously to painting at the beginning of the 16th century she had only to appropriate the traditions of other schools to perfect an instrument through which to express her sensuous idealism. With undisguised love of gayety and worldly splendor she turned as inevitably to color and its fullest development through oil technique, as the intellectual temperament of the Florentines revealed itself through the incisive strokes of fresco. In 50 years she reached her full maturity in a mastery of the structural use of color, and a painting of the tones of the atmosphere in which the subject was bathed; this Venetian glow was recalled in modern times in the experiments of CLAUDE MONET (1840-1926). The pioneer work of perfecting color technique was carried out by the Bellini family. Carpaccio (1450-1522) was the gay story-teller of the Venetians and introduced the fashion of contemporary costume and customs. GIORGIONE (1478-1510) was one of the first masters to bring color into the substance of his pictures and infused into them the spirit of poetry and romance. He was one of the great painters of the world both in mastery of technique and conception. But the greatest of these was TITIAN (c. 1477-1576) who was grounded in the lyric quality of Giorgione and during the long span of his life was ever growing and expanding until he covered nearly the whole range of expression. His knowledge of his craft was as deep and far-reaching as his understanding of human nature. TINTORETTO (1518-94) was the dramatic virtuoso of the age. He combines many of the traits of both Titian and Michelangelo on a plane more obvious and not so fine. Veronese (1528-88) was the last great Venetian painter and his works are typical, in the portrayal of the prevailing pageantry and glorification of luxury of Venetian decadence.

Sculpture. It was natural that Florence produced most of the great sculptors of the Italian Renaissance, beginning in the 13th century with Nicola Pisano, and culminating with Michelangelo in the 16th century. From Pisano on, the sculptors avowedly owed their stimulation to a close study of antique models, but the naturalistic and spirited vigor of their works suggest that this was confined chiefly to mental discipline and restraint, for there is little in common in them with the serenity of Greek statues. DONATELLO (c. 1386-1466) was the first great sculptor of the new era, giving it its trend toward naturalism through his scientific understanding of form and structure. LORENZO Ghiberti (1378?-1455), on the other hand, continued the medieval tradition, with an added naturalistic quality in his famous bronze doors, which Michelangelo said were "worthy to be the gates of Paradise." LUCA DELLA ROBBIA (1400?-82) revived the ancient Etruscan art of terra cotta, adding the

RENAISSANCE ART



1, 3, COURTESY METROPOLITAN MUSEUM OF ART

ART OF THE ITALIAN RENAISSANCE

1. Portrait bust of John the Baptist by Mino da Fiesole (1431-84). 2. The Three Graces, a detail of the "Primavera," or Spring, by Sandro Botticelli (1444-1510), in the Uffizi Gallery, Florence. 3. Terra cotta sculpture of the

Madonna and Child by Donatello (1386?-1466). 4. Interior view of a room in the Villa Madama, Rome, designed by Raphael for Cardinal Giulio de' Medici and decorated by Giulio Romano.

RENAISSANCE ART



COURTESY METROPOLITAN MUSEUM OF ART

ENGRAVING IN THE ITALIAN RENAISSANCE

1. "The Fighting Men," by Antonio Pollaiuolo (1429-1498), notable for human figures in violent action.
2. "The Entombment," by Andrea Mantegna (1431-1506). The composition of this work influenced all later engraving.

RENAISSANCE ART



COURTESY METROPOLITAN MUSEUM OF ART

SIXTEENTH CENTURY FLEMISH AND FRENCH PAINTING

1. "Rest on the Flight into Egypt," by an unknown painter of the Flemish School.
2. "Orpheus Asking the Way to Hades," by Nicolas Poussin (1594-1665), French.

beauty and charm of polychrome glaze. Andrea del Verrocchio (1435-88), famous as painter as well as sculptor, brought an accomplished technique to all he did. The apogee of sculpture, as in painting, was reached by Michelangelo. It was as a sculptor he signed himself, and if his greatness rests more on his painting it was due to his initial mastery of bending stone to his will. *See also* RENAISSANCE; RENAISSANCE ARCHITECTURE.

BIBLIOGRAPHY—Crowe and Cavalcaselle, *New History of Painting in Italy*, 1909; Élie Faure, *Renaissance Art*, 1923; F. J. Mather, *History of Italian Painting*, 1923; B. Berenson, *Italian Painters of the Renaissance*, 1930

RENAN, ERNEST (1823-92), French writer and Orientalist, was born at Tréguier, Brittany, Feb. 27, 1823, the son of a mariner. His mother was anxious for him to enter the priesthood. As a schoolboy he showed such brilliance that he was enabled to complete his education in Paris. In 1840 he entered a seminary and then proceeded to the Collège de St. Sulpice, where, after a prolonged struggle, he found that his religious convictions had deserted him. Abandoning all idea of entering the priesthood, he became an usher in a boy's school, making researches in Semic philology during his spare time. He settled in Paris with his sister, and began writing on Oriental subjects for the periodicals, meeting with such success that Napoleon III entrusted him with an archaeological mission in Phoenicia. Renan set out in 1860 with his sister, and later proceeded to Syria, where in 1861 his sister died and he himself became dangerously ill. In 1863 he published his celebrated *Vie de Jésus*, the fruit of his researches in Syria. From this time onwards Renan lived entirely by his pen, having been deprived of his chair of Hebrew in the Collège de France owing to his unorthodox views. He completed his monumental *Origines du Christianisme* at 60 years of age. Renan died in Paris, Oct. 12, 1892.

BIBLIOGRAPHY.—W. F. Barry, *Life of Ernest Renan*, 1905; L. F. Mott, *Ernest Renan*, 1921.

RENAUDOT, THÉOPHRASTE (1586-1653), first French journalist, was born in London in 1586. By profession a doctor, he was presented to Cardinal Richelieu in Paris, and through his influence became the king's physician in 1612, besides holding other important posts. His office was soon the center for all Paris information, and Renaudot wrote little news-sheets which he handed to his patients. Later he had them printed, and they eventually developed into a journal called the *Gazette*. He opened a free clinic in 1635, and a philanthropic pawnbroker's establishment. The scandalized Paris doctors went to law against him, for he had no Paris medical degree and could not legally practice there. Banned from his profession, he devoted himself to the *Gazette*. Renaudot died at Paris, in poverty, Oct. 25, 1653.

RENI, GUIDO. *See* GUIDO RENI.

RENNES, the capital of ancient Brittany until the duchy passed to France in 1491, now the capital of the department of Ille-et-Vilaine. Of its historic

importance few traces remain for the old town was almost entirely destroyed by a 7-day fire in 1720. Rennes possesses one of the best provincial museums in France and a university. It has tanneries, foundries, and wood-work industries. Pop. 1931, 88,659.

RENNET, the liquid or granular extract, obtained from the stomach of certain young ruminants such as calves and pigs. It has the power of curdling milk. Commercial rennet is made chiefly from the cleaned and dried fourth stomach of calves. The product is largely used to hasten the coagulation of milk in cheese making, an ounce being sufficient to curdle several hundred pounds of milk in a manner that brings about the desired form of ripening.

RENO, a city in western Nevada, the county seat of Washoe Co., situated on the Truckee River, at the base of the Sierra Nevada Mts., 32 mi. northwest of Carson City. The Southern Pacific, the Western Pacific and the Virginia and Truckee railways serve the city, as well as airplanes and bus and truck lines. It is the commercial center of the state, and has such manufactures as packing house and lumber products, soap and explosives. The shipment of wool, livestock, potatoes, and mining machinery afford considerable industry. In 1929 the value of the manufactures was about \$3,000,000; the retail trade amounted to \$18,759,412. Reno is the seat of the UNIVERSITY OF NEVADA and the Mackay School of Mines. The University maintains an Agricultural Experiment station and a stock-farm; and also affiliates with the State Agricultural Experiment Station, the State Analytical Laboratories for Pure Food, Drugs, Weights and Measures and various other state activities. A few miles southeast is Comstock-Lode, the celebrated mining center. Owing to the laws regarding divorce the city has many temporary residents. Reno was founded in 1859 and first chartered as a city 1899. Pop. 1920, 12,016; 1930, 18,529.

RENSSELAER, a city in Rensselaer Co., eastern New York, situated opposite Albany on the Hudson River. It is served by two railroads and shares by ferry the transportation conveniences of Albany and the deep-water harbor, forming with Albany the Albany-Rensselaer Port District. The city has rayon, shirt, dye, felt, clothing, shoddy and medicine factories and large railroad shops. It is the distributing center for large oil companies. The manufactured products, 1929, were valued at \$15,833,257. The retail business in 1929 amounted to \$4,076,241. Rensselaerwyck, a large tract of land, including the village of Greenbush, was founded in 1631; incorporated in 1815. It was renamed Rensselaer and chartered as a city in 1897. Pop. 1920, 10,823; 1930, 11,223.

RENSSELAER POLYTECHNIC INSTITUTE, a non-sectarian technological college for men founded in Troy, N.Y., by Stephen Van Rensselaer in 1824. It was the first school of science and engineering in the United States, and is said to be the first such school having a continuous existence to be established in any English-speaking country. The institute comprises the departments of Civil Engineering, Me-

chanical Engineering, Electrical Engineering, Chemical Engineering, Arts, Science and Business Administration, and courses in physics, chemistry and pre-medic. It had productive funds in 1931 amounting to \$5,900,000. The library contained 22,468 volumes. In 1931-32 there were 1,690 students and a faculty of 140, headed by Pres. Palmer C. Ricketts.

RENT, a term usually meaning land rent, and so used by all the earlier English economists. Land rent was sharply distinguished from other forms of **INCOME** because it was supposed to be governed by laws of its own. Broadly speaking, **WAGES**, **INTEREST** and **PROFITS** were regarded as payments for services, each of which involved a certain real cost. Land rent, on the contrary, was payment for what was originally a free gift of nature and costless. In the Ricardian rent doctrine (*see* D. RICARD), rent can be exacted only for **LAND** superior, either in fertility or in location, to the worst land actually required for economic purposes. Cost of production on this latter, or marginal, land determines the price of product, but contains no rent. Hence, it was argued, payment of rent does not increase price. From this point of view, all land rent is a differential. It goes, not to the **ENTREPRENEUR** as profits, but to the land owner, simply by reason of his power to get it. Later it was recognized that all land, however infertile or badly situated, may yield rent. There is therefore a scarcity as well as a differential element in rent. The Ricardian doctrine, variously modified and refined, is still held by many orthodox economists. Weighty objections have damaged its standing, however, and many economists now reject the idea that land rent is not a part of price-determining **COST OF PRODUCTION**.

It is now recognized that land rent is only one, though the most important, species in a whole genus of differential returns received by possessors of superior instruments and powers. Thus there is rent of natural ability and rent of business capacity, and a profit derived from investment in fixed **CAPITAL** is sometimes regarded as a rent. A. B. W.

Rent, in law, is a compensation either in money, chattels, or labor, reserved for or received by the owner of land from one in occupation thereof. At common law it was a certain profit arising yearly from lands and corporeal tenements, and was said to be an incorporeal hereditament, i.e., the right to receive the rent was inheritable and passed to the heir rather than the personal representative of the person entitled. At common law where there is a covenant to pay rent, destruction of buildings upon, or injury to the leased property short of absolute destruction, does not excuse from payment of the rent. This rule has been modified in some jurisdictions by legislation, and in some by judicial decision.

RENWICK, JAMES (1818-95), American architect, was born in New York City, Nov. 3, 1818, and graduated from Columbia University. He served for several years as architect for the Erie Railroad. His fame rests upon two of the finest modern examples

of French Gothic architecture—Grace Church (1845) and St. Patrick's Cathedral (1879), New York City. He was also architect of the Smithsonian Institution and the first Corcoran Art Gallery in Washington; the original hall of Vassar College; and other notable buildings. He died in New York City, June 23, 1895.

REPARATIONS, compensation imposed by states victorious in a war upon the defeated adversary. **INDEMNITY** refers to money damages, and may include not only damages for material injury and losses, but war costs. Reparation implies rather compensation for actual damages. In the Treaty of Versailles the term reparation is used probably because the collection of war costs was ruled out in principle, and because reparation connotes more clearly atonement for guilt.

REPARATIONS, GERMAN. At the end of the World War, reparations were imposed by Article 232 of the Treaty of Versailles which in part states: "Germany accepts the moral responsibility for having caused all damage suffered as a consequence of the war." The treaty of Versailles did not fix the total amount to be paid but merely created a Reparation Commission invested with wide powers and which was to notify Germany on or before May 1, 1921 what the amount was to be. From the conclusion of the Treaty of Versailles up to May 1, 1921, the Commission held a number of conferences to decide the total amount of German indebtedness. At the Boulogne Conference in June 1920, the Allies proposed to demand of Germany an annuity of 3,000,000,000 **GOLD MARKS** to be paid from May 1, 1921 to Apr. 30, 1926 and an **ANNUITY** of 6,000,000,000 gold marks to be paid from May 1, 1931 to Apr. 30, 1963. The total aggregate of these annuities was 269,000,000,000 gold marks. After these figures were decided upon, they were to be brought up again for discussion at the Spa Conference at which German representatives were to be present. The Spa Conference was held in June 1920, but no agreement was reached between Germany and the Allies. The Allies among themselves, however, agreed upon a method of distributing German reparations among the various recipients as follows: France to receive 52%, British Empire 22%, Italy 10%, Belgium 8%, Japan and Portugal, 1.50%, others, 6.50%.

In Jan. 1921 the Supreme Economic Council met in Paris where the Allied Powers agreed upon the following amounts to be paid by Germany:

From May 1, 1921 to Apr. 30, 1923—2,000,000,000 gold marks
 May 1, 1923 to Apr. 30, 1929—4,000,000,000 gold marks
 May 1, 1929 to Apr. 30, 1932—5,000,000,000 gold marks
 May 1, 1932 to Apr. 30, 1963—6,000,000,000 gold marks

The total amount of these payments aggregated 226,000,000,000 gold marks, an amount equivalent to the damages done by Germany to the Allies as computed by the Reparation Commission. Since these proposals were not accepted by the German representatives, the Reparation Commission met again in April, 1921, in London, and, with the approval of

the Supreme Economic Council, declared Germany's total debt to cover reparations to be 132,000,000,000 gold marks. This decision was presented in the form of an ultimatum to the German government and was accepted by the latter.

Under the LONDON AGREEMENT of 1921, Germany was to turn over three classes of bonds—Series A amounting to 12,000,000,000 gold marks and series B, amounting to 38,000,000,000 gold marks, to be delivered to the Reparation Commission in 1921 and to bear 5% INTEREST and 1% amortization; and series C, amounting to 82,000,000,000 gold marks to be turned over to the Reparation Commission at a time specified by it. Until the complete payment of the total amount Germany was to pay annually 2,000,000,000 gold marks plus 26% of the total exports of the country. In order to liquidate this entire amount of 132 billion gold marks in 37 years, at 5% interest and 1% amortization, a debt is liquidated in 37 years, Germany would have had to pay an annuity of 7.9 billion gold marks.

The amount fixed in London was legally in force until the adoption of the YOUNG PLAN. Germany could not meet these obligations in full and after a number of conferences and delays the French and Belgian armies occupied the Ruhr early in 1923. The collapse of the German currency and the dangerous state in which German national economy found itself, necessitated the handling of the reparations question on a different basis, which resulted toward the end of 1924 in the formation of the so-called Dawes Commission. [See also DAWES PLAN.] The Lausanne conference agreed on July 9, 1932 to reduce the reparations due after that date to 3,000,000,000 gold marks. This accord was conditioned upon a "satisfactory settlement" of war debts. M.N.

BIBLIOGRAPHY.—C Bergmann, *The History of Reparations*, 1917; R. L. Buell, *International Relations*, 1929.

REPERTORY THEATER. In theatrical parlance repertory refers to a list of productions kept ready for performance by a theater. In Greek days when plays were produced for one performance only the repertory offered no difficulties. As the demand for theatrical entertainment increased the manager of a successful production had two alternatives. He could keep the play in performance until the demand was exhausted; or he could withdraw it and hold it ready for production at a later time, meanwhile producing other plays. The first plan involves artistic disadvantages, but is economical. The second plan involves such expense and such difficulties in management that it is prohibitive for a self-supporting theater. For this reason in recent years the demand for a repertory theater has been tied up with a demand for some form of subsidy, either by the state, by philanthropy, or by an organized audience.

As a rule the repertory system requires a single management, operating in a single theater, with an established company, a more or less stable clientele, and definite principles of play-choice and production. As the true repertory theater is rare, the term is often

loosely applied to an undertaking that presents a coherent program of plays, or rests upon a stock company. The repertory system probably developed from the system of production of the *commedia dell'arte*. Put into effect by MOLIÈRE, it became the basic principle of the *Comédie Française*. It was also the system of the endowed theaters set up by German princes in the 18th century, and has continued in the Court and Municipal theaters of Germany, Austria and Russia. The programs of these theaters were as a rule based on the older plays. When the movement for art theaters began these were organized on the repertory principle, notably Max Reinhardt's theaters in Germany and the Moscow Art Theatre in Russia. The programs of these theaters tended to rest upon the works of innovating playwrights, and upon revivals of neglected masterpieces.

Theoretically the arguments are almost entirely in favor of the repertory theater. But it is difficult to put the theories into practice. Against the faults of the star system (magnifying the personalities of actors), and the long run system (making the actors automats and monopolizing the stage), the repertory system in theory has the advantage of frequent changes of bill for the benefit of actors and audience. However, the expense of conducting a repertory theater under the social and cultural conditions of modern life is such that it can exist only when circumstances as to audience, players and management are unusually fortunate. It has been demonstrated many times that lavish funds are not enough. To these there must be added masterly management. In England before the World War the repertory system had a significant try-out both in London and the provinces. The Court Theater, 1904-07, although not a true repertory theater, offered many of its best features. After this came Charles Frohman's 17 weeks' experiment with a repertory theater in the Duke of York's Theater, 1910, in which 128 performances of ten plays were given. Among the provincial repertory theaters were the Abbey Theatre, Dublin, founded 1904 (see IRISH THEATER), the Manchester Repertory Theatre, 1907-21, the Birmingham, Liverpool and Glasgow theaters. In America the Washington Square Players (begun 1915), and the Neighborhood Playhouse (1915), were modified repertory theaters to the extent that they had settled companies and short runs. They did not regularly return plays to the program. The New York Theater Guild has taken further steps toward full repertory without quite reaching it. Although not regularly returning plays to the program the directors overcome some of the prohibitive expense of short runs and frequent changes of bill by sending plays out to secondary theaters and by the creation of provincial circuits. All the above theaters have supported the newer schools of writers. The only true repertory theater in America is the Civic Repertory Theater managed by EVA LE GALLIENNE; the program of this theater is built largely on imported plays. The Metropolitan Opera House is of course conducted on the repertory plan, as have been

various German stock theaters established in New York and elsewhere. See also AMERICAN THEATER; MODERN BRITISH DRAMA. T. H. D.

BIBLIOGRAPHY.—Archer and Barker, *Scheme and Estimates for a National Theater*, 1908, P. P. Howe, *The Repertory Theater*, 1911, Dickinson, *The Insurgent Theater*, 1917, K. Macgowan, *Footlights Across America*, 1929.

REPLEVIN. An action to recover possession of personal property. Originally this action lay only where property had been taken under distress, and it was claimed that the distraint was unlawful. In the United States it has been extended to cover all cases where one person claims an immediate right of possession of chattels held by another. A writ issues directing the sheriff to take the property and turn it over to plaintiff upon his giving security to turn it back in case he fails in the action.

REPORTER, an employee of a newspaper who reports the fact of any event that may interest the reading public. In the United States there are upwards of 80 departments or schools of journalism offering specialized training for newspaper work; and while to-day, as in the past, first work as a "cub" reporter may not offer much in the way of pay to a young man, it is a necessary and interesting preliminary apprenticeship to positions of importance in the journalistic organization that gathers and disseminates news.

A reporter must record only that which actually occurs without allowing his own or his employer's opinions or feelings to color his account of what is witnessed. He should have a pronounced flair for news, as well as the ability to quickly apprehend the relative importance of the facts and to organize them in a readable story.

The gathering of news has become a far-flung and highly organized function of modern life. Beside the usual newspaper reporter, there are a myriad of specialized reporters covering special fields of news such as the happenings in law courts, the news of shipping, finance and other activities. R. O.

REPORTS. Since a report is fundamentally the communication of information or counsel which is desired and which will be used by some one for a particular end, its success depends primarily on its being planned carefully to meet all the conditions under which it is to serve. The introduction should present a clear statement of the subject, of the purpose, and of the plan of organization of the material treated. It often also includes a brief statement of the conclusion, or recommendation, and sometimes a summary of results or findings. The conclusion should agree and balance logically with the introduction. The body of the report should be so written as to make evident the structural design announced in the introduction. Ideally a report should read coherently and smoothly, and should bear evidence of the writer's mastery of his subject matter in its larger aspects as well as in its most minute details. J. R. N.

REPOUSSÉ, ornamental work made by pressing or hammering thin metal up into a design. The ham-

mering is done on the back of the finished article and produces a design in relief which is perfected on the outside with chasing tools. Special hammers with adjustable heads have to be used to work inside of vases and similar articles. The art was extensively practiced on bronze, as well as on gold and silver, by the early Egyptians, Assyrians, Phoenicians and Etruscans. BENVENUTO CELLINI, Florentine goldsmith and sculptor, produced the finest examples of repoussé work.

REPPLIER, AGNES (1858-), American essayist, was born in Philadelphia, Pa., Apr. 1, 1858, and educated at the Convent of the Sacred Heart, Torresdale, Pa. The ironic, lively style of her articles which appeared in *Scribner's Magazine* and the *Atlantic Monthly* soon attracted attention. Among Miss Repplier's works are *Books and Men*, 1888, *Points of View*, 1891, *Essays in Miniature*, 1892, *Philadelphia. the Place and the People*, 1898, *The Cat*, 1912, *Père Marquette*, and *Mère Marie of the Ursulines*, 1931.

REPRESENTATION. Historically, an attempt has been made to solve the problem of representation by the geographical division of the state into a number of electoral districts (see ELECTORAL SYSTEMS), usually with some reference to the relative population of each, and the allotment to each such district of a seat in the legislature. This procedure does not necessarily insure adequate representation of the various interests in the state, however, for in a single-member election district obviously only one point of view can secure representation. For this reason the various schemes of PROPORTIONAL REPRESENTATION have been suggested. The problem is not as simple as the mere development of adequate machinery of election, however. Years ago JOHN C. CALHOUN forcibly called attention to one of its most difficult phases, viz., the protection of the rights of minorities (see MINORITIES, PROTECTION OF). His famous doctrine of concurrent majorities had as its underlying assumption a belief that there were situations in which the interests of the MAJORITY and those of the MINORITY were so divergent as to be irreconcilable. Such he believed was the case in the clash between the interests of the slave states and those of the free. He proposed consequently a scheme of representation which would give to each interest the power to exercise a VETO on all matters of fundamental importance to it. To this end the minority were to be given undue representation in the upper house. Actually, curiously enough, such a condition has evolved in a number of American commonwealths in connection with the representation of agrarian and urban interests. S. C. W.

REPRESENTATIVES, HOUSE OF, the lower house of the CONGRESS of the United States composed of representatives apportioned (see APPORTIONMENT) among the states in proportion to their population. A member of the House must be at least 25 years of age, seven years a citizen (see CITIZENSHIP) of the United States, and an inhabitant of the state from which he is chosen. His term of office is two years. Together with the SENATE, the House of Represen-

tatives constitutes the legislature of the United States. In the exercise of its powers, however, the House is limited to the authority conferred upon it by the Constitution. For the most part this grant of authority falls into seven broad categories: the first relating to financial matters; the second dealing with the control of foreign relations; the third the war powers; fourth, the supervision of interstate and foreign commerce; fifth, control over Federal territory and the admission of states; sixth, control over citizenship and NATURALIZATION; and finally, a group of miscellaneous powers. In line with the English tradition, a provision is to be found in the Constitution to the effect that "all bills for raising revenue shall originate in the House of Representatives."

S. C. W.

BIBLIOGRAPHY.—S. C. Wallace, *Our Governmental Machine*, 1924, C. A. Beard, *American Government and Politics*, 1928.

REPRIEVE, in law, a withholding of punishment. Judges have this power, also executives, such as the ruler of a country or the governor of a state. For example: If new evidence has been found which would tend to overturn the conviction, the sentence or execution is sometimes delayed.

REPRISAL, the seizure or arrest of goods or trade of subjects of a state as an offset for injuries sustained. The state does not attempt to respond necessarily in manner, kind or degree, but it does attempt to assess the damage sustained and to recover for the amount of the injury in some substantial form. Reprisals are used to gain the ends of justice when they cannot be gained in any other way.

REPRODUCTION. The production of new individuals finds its necessity in the biologic requirement of continuity of life despite the occurrence of death as an inevitable terminus to individual existence. Correlated with the destructive action of the struggle for existence the need for a certain characteristic degree of multiplication is necessary.

In the simplest forms of life (*Protista*) mere division is the dominant mode of reproduction. Division or fission of each individual produces two in place of one. In a relatively short time this results in enormous numbers. It is only, however, in a constant and favorable environment that fission is fully effective. To meet unfavorable life conditions there is the supplementary method of reproduction, spore formation, or sporification. Spores are minute reproductive elements highly resistant to drying and unfavorable temperatures. Spore formation is abundantly illustrated among the simpler forms of life and is highly developed among plants. See ALTERNATION OF GENERATIONS; LIFE CYCLE.

The term spore is also applied to the often numerous new individuals formed by multiple fission. Unfavorable conditions also are met quite apart from reproduction through encystment, the secretion of an outer impervious envelope. Unequal fission, i.e., the separation of a more minute moiety which by growth subsequently attains the typical size, is much like multiple fission. It is also termed budding, a term

perhaps better reserved for the method of propagation well illustrated in certain animals and in many of the higher plants wherein a portion of the body furnishes a separate unitary growth. Where such buds remain attached the composite is frequently termed a colony. These colonies are essentially individuals of a higher order and here the definition of an individual becomes difficult. Budding like fission is a method of multiplication without the formation of specific reproductive elements, as spores or gametes.

The methods involving the reproductive activity of a single individual are frequently termed monogonic as contrasted with the greatly predominant method wherein there is a fusion of reproductive elements from two individuals, amphigonic reproduction. Indeed, in most forms which exhibit monogonic reproduction it has been found that sooner or later some form of fusion of material from two individuals occurs.

Amphigonic reproduction assumes various forms. Nuclei alone may fuse, as in karyogamy. Here two individuals join together temporarily, exchange nuclei and then separate. The exchanged nuclei fuse, each with another nucleus. This method, called conjugation, is illustrated in the ciliate protozoa. The union is permanent in many protista and is called syngamy, and while in some forms the conjugating individuals are equal, known as isogamy, in others, they are unequal in size, known as heterogamy. They are then distinguished as microgametes and megagametes, thus foreshadowing among unicellular animals and plants true sexual reproduction so characteristic of many-celled forms.

In sexual reproduction the microgamete, termed the sperm cell, spermatozoon or spermatozoid, fuses with the megagamete, the egg cell or ovum. The product of the fusion, the zygote, then undergoes a characteristic development to the mature individual. The two forms of gametes are usually produced in separate individuals, male and female, the process of their production being respectively termed spermatogenesis and oogenesis.

Although amphigonic reproduction is so nearly universal, the biologic advantage is not clear. It is obvious that the introduction of nuclear material is the essential accomplishment. Whether this effects a rejuvenescence, a heightened growth potential, or induces increased variation is not fully clear, but evidence favors the latter.

B. F. K.

REPRODUCTIVE ENGRAVING, distinguished in this description from original painter-engraving (see PAINTER-ENGRAVER), in which the artist designs and executes his own blocks or plates. It ranges from the skilled craftsmanship of facsimile work to an interpretative art, calling on the engraver to translate into lines or tones the work of another artist in another medium, such as painting.

Before the advent of PHOTOGRAPHY, practically all the forms of print-making covered by the general term "engraving" were used for reproduction. These fall into three groups: INTAGLIO processes, where the

printing ink is held in lines incised below the surface of the plate, as in etching and line-engraving; relief processes, like wood-cutting and wood-engraving; and surface processes, represented by LITHOGRAPHY. This last is not in the derivative meaning of engraving. Before discussing the development of reproductive engraving, it is desirable to explain briefly the various processes:

Wood Engraving. Engraving on wood involves cutting away the block except where it is to print. In woodcutting, which is done with a knife on soft wood, the lines of the design are left in relief to take ink, and print black on white. In wood-engraving the lines are incised with a graver used on hardwood, the upstanding surfaces are inked, and the design prints white on a black ground. Black lines can be produced by this process. *See WOOD-ENGRAVING.*

Line Engraving. This is the cutting of a design into a metal plate, usually of copper, with a steel tool called a graver or BURIN. STEEL-ENGRAVING is merely line-engraving on steel.

Etching. This is a form of engraving in which the lines are incised or "bitten" by the action of acid instead of by means of a tool. *See ETCHING.*

Dry-Point. This is often erroneously classed as etching, though the lines are not bitten with acid but are scratched into the bare plate with a point. The retention on the plate of delicate ridges of copper ploughed out of the lines gives the dry-point print its character. *See DRY-POINT.*

Aquatint. This is a form of etching in which the design is developed in broad, flat tints sometimes reinforced by line. The "tint," which is a grain, not a color, is produced by etching a plate previously powdered with resin. *See AQUATINT.*

Mezzotint. This is an engraving process producing soft tones. The mezzotinter first roughens his plate like a microscopically fine nutmeg-grater. Then he smooths down or "scrapes" in his design. *See MEZZOTINT.*

Stipple. Stipple-engraving is etching in dots instead of lines, with a point or with a dotting-wheel; the etching-ground is pitted with dots, exposing the copper to the acid. *See STIPPLE.*

History. The earliest form of engraving was woodcutting, which developed to an art of great distinction in Europe during the 15th and 16th centuries. Even such master designers as ALBRECHT DÜRER and HOLBEIN the Younger entrusted to skilled wood-carvers the cutting of their blocks. After 1700 the woodcut was largely supplanted for fine book-illustration by line-engraving on copper. Crude woodcuts long persisted in cheap books.

Developing as an original art a generation after woodcutting, with Dürer and Mantegna as its great pioneers, line-engraving early manifested its fitness for reproductive work. In 1481 appeared an edition of Dante with engravings by Baldini after Botticelli's drawings. In the 16th century Raphael sponsored Marcantonio's engravings after his own drawings, and in the 17th century RUBENS directed a group of en-

gravers who rendered his paintings in black and white.

The 18th century saw line-engraving largely given over in Italy to reproduction of the old masters, and in France to finished rendering of paintings by the



ST. STEPHEN

From a copper engraving by Martin Schongauer (1420?-1488?)

WATTEAU school. This was the period of the British mezzotinters and stipple-engravers, who reproduced contemporary portrait and genre painting, and of aquatint for landscape work.

Etching, dating back to the late 15th century, appears to have remained until modern times a purely original art. About the middle of the 19th century brilliant groups of reproductive etchers appeared in France and in Germany, among them Walther, Unger, Flameng and Chauvel. This movement was manifested later in the United States.

Copperplate methods or, after 1830, steel engraving, were highly esteemed for book and periodical illustration during the first half of the last century. The field was already being disputed, however, by the developing art of wood-engraving.

About 1790 the English engraver, THOMAS BEWICK, revolutionized the old woodcutter's technique, supplanting it by modern wood-engraving. The possibilities of his white line method were slow of general realization, but by 1860 it was supplanting other reproductive processes. Its period of highest development belongs to American engraving.

From the pathetic crudities of Revolutionary print-making, American engraving progressed in the early 19th century to a degree of technical competency. Skillful English engravers had been added to the ranks, notably W. S. Leney, John Hill, the aquatinter, John Sartain and later, Robert Havell. Native-born

ability was beginning to show itself. If much of the portraiture reproduced in line, stipple and mezzotint, was "poor but respectable," the names of talented engravers like Asher B. Durand, James Smillie and Longacre stand out. By the middle of the century American banknotes, upon whose portrait vignettes many of the best engravers worked, were known the world around.

Of importance in the development of American engraving were illustrated publications like gift-annuals, the portrait "repositories" and landscape portfolios in which the best work of some engravers appeared. The standard of American magazine illustration steadily rose, more delicate technique with greater emphasis on tone and texture marking the work toward 1870.

With the practice of photographing the painting to be reproduced directly on the engraver's block began that elaboration of the white-line method which led to the brilliant exploits of the so-called new school of wood-engraving. Such men as Timothy Cole, Juengling, Heinemann, Henry Wolf and Kruell displayed amazing virtuosity in rendering the tonal nuances and brushwork of the original. When photo-mechanical processes supplanted wood-engraving as a reproductive art, several members of the new school, notably Closson and Elbridge Kingsley, carried their technique into direct engraving from nature.

REPTILES or **REPTILIA**, a class of animals which bridge the gap between the amphibians, on one hand, and the birds and mammals on the other. Like the amphibians the reptiles are cold blooded (i.e., their temperature is dependent on that of their environment), but unlike the amphibians, and like the birds and mammals, they have lungs and breathe air throughout their lives. The young of reptiles are thus hatched or born on land. Even marine turtles return to land to lay their eggs.

Only four orders of reptiles are represented by living forms. These are the tuatara or sphenodon (*Rhynchocephalia*); tortoises, terrapins and turtles (*Chelonia*); crocodiles, alligators and gavials (*Loricata*); and lizards and snakes (*Squamata*). Millions of years ago, however, in Mesozoic times, reptiles had their golden age. For at least 10 million years they were the dominant animals on earth, so much so that the Mesozoic era is often called the Age of Reptiles. Over 10 orders, and many sub-orders, are known to have existed. The reptiles of the past were a most highly diversified group. The dinosaurs, for example, included small animals hardly larger than a chicken, huge vegetable feeders like the 70-ft. *Brontosaurus*, great kangaroo-like carnivores, such as *Tyrannosaurus rex*, which stood 18 ft. high, and was 47 ft. long, and heavily armored creatures like *Stegosaurus*. Other ancient reptiles, as the Plesiosaurs and Ichthyosaurs, had become modified for life in the water, while the Pterodactyls were adapted for flight.

Modern reptiles are few in number and small in size, strength and importance by comparison with their predecessors. Still, a 30-ft. python, a Nile croco-

dile, a king cobra, or a diamond rattlesnake can be considered neither tiny, weak nor insignificant. They are characterized by their dry skin covered by horny scales. In this connection it is interesting to note that both birds' feathers and mammalian fur have evolved from reptilian scales. The carapace or "shell" of the chelonians is a specialized structure, involving both external skeletal elements and greatly modified spinal processes and ribs of the internal skeleton.

Most reptiles have sharp teeth for holding their prey; the chelonians, however, have only a knife-edge beak. They are typically four-legged, but the limbs are absent in snakes and in some lizards. Truly aquatic turtles, like the leatherback and the hawksbill, have their limbs modified to form paddles. A few lizards are capable of volplaning through the air. The most interesting are the flying dragons of the East. Their "wings" do not involve their limbs; they are large fan-like membranes stretched on enormously elongated ribs, and can be folded up when not in use.

The headquarters of the reptiles is in the tropics. Lizards, terrapins and turtles are met in temperate lands, and SNAKES, by virtue of their instinct to hibernate deep below the frost line, can live where the winter months are very cold. No reptile could endure truly arctic lands, but wherever it is warm enough they are represented. They have even colonized the inhospitable desert regions.

Reptiles include vegetarians, carnivores, and omnivorous feeders. Carnivorous species commonly capture their prey by swift moving and skill. The boa constrictor, which drops on its victim from the limbs of trees, may be said to depend largely on stealth. And the venomous serpents, of which there are relatively few forms, are aided by their poison, which, when injected, paralyzes the prey.

Among reptilian methods of defense speed figures largely, especially for lizards and snakes. Many forms are protectively colored. Poisonous species are often warningly colored; the venom is usually used only as a last resource. Slow-moving land tortoises are adequately protected from most enemies by their enormous shells which form portable forts into which their heads, limbs and tails can be completely withdrawn. Lizards have the amazing ability to break off their tails, sometimes if cornered, sometimes if seized. The wiggling tail usually occupies the attention of the enemy while the animal escapes. It soon replaces its lost member by new growth.

Most reptiles lay eggs which are hatched by heat, derived either from the sun or from fermenting vegetation. Many snakes bring forth their young alive. Among both oviparous and viviparous forms there are instances of maternal care, but the young more frequently have to fend for themselves.

Reptiles are not often directly useful to man. Certain species, the green turtle, the hawksbill and the diamond-backed terrapin, for example, are famous as material for soup. Insectivorous forms, such as the chameleon, and rodent-eating snakes, which include

the maligned rattlers, are of service in keeping down the numbers of insect pests and mice and rats. See also LIZARD; TERRAPIN; TORTOISE. A. I. W.

REPUBLIC, a term used to denote a particular type of governmental organization. The two "great points of difference between a republic and a democracy," said Madison in the *Federalist*, "are, first, the governing power in a republic is delegated to a small number of citizens elected by the rest, and second, a republic is capable of embracing a larger population and of extending over a wider area of territory than is a democracy. In a democracy the people meet and exercise the government in person; in a republic they assemble and administer it by their representative agents." Madison, of course, was trying to differentiate between a republic and a pure DEMOCRACY, but in so doing he set forth the salient characteristics of a republic. By definition the possibility of hereditary tenure is precluded. Nor can a government based upon an exceedingly restricted SUFFRAGE claim the appellation. Two major types of Republican organization are the cabinet form and the presidential. In the modern era the Republic of France and the United States of America constitute perhaps the outstanding examples of governments organized on Republican principles, although the general adoption of this form of government throughout both Europe and Latin America makes any attempt at such a characterization exceedingly dubious, if not dangerous.

S. C. W.

BIBLIOGRAPHY.—J. W. Garner, *Introduction to Political Science*, 1910.

REPUBLIC, THE, a noted dialogue on ethics and the ideal state by PLATO, in 10 books. This work embodies more completely than any other the ancient philosopher's ideas on government, education and morals. It pictures an ideal monarchy or aristocracy, wisely governed by a philosopher-statesman. The citizens of the proposed state find their happiness in virtue, which is made practicably attainable by a correct division and specialization of labor, by limiting the right of private property, by reforming the letter of the laws and saving their spirit, and by improving the race by artificial selection. Other suggestions provide for the political and industrial equality of women, reformed education, the proscription of unwholesome works of art and the endowment of scientific research. Many of the basic ideas of *The Republic* are today still sound and applicable.

BIBLIOGRAPHY.—Standard edition, B. Jowett and L. Campbell, *Plato's Republic*, 1894; standard trans., B. Jowett, *The Republic of Plato*, 3rd ed. 1908; R. L. Nettleship, *Lectures on the Republic of Plato*, 2nd ed. 1901; E. Barker, *Great Political Theories: Plato and his Predecessors*, 1918.

REPUBLICAN PARTY, one of the two major political parties of the United States. It was organized at Jackson, Mich., July 6, 1854. Afterwards the party attracted to it a large part of the same economic and social groups which had composed the Federalist (see FEDERALISTS) and Whig parties (see WHIG PARTY); but at its inception its dominant policy and avowed purpose were to combat the extension of

slavery. At the Jackson meeting resolutions were adopted which demanded the repeal of the Kansas-Nebraska Act, 1854, and the Fugitive Slave Law, 1850, and denounced slavery as a political, moral and social evil. The new party recruited its members from the Free Soilers (see FREE SOIL PARTY), the expiring Whig Party, and the numerous Anti-Nebraska Democrats, the latter being opponents of the Kansas-Nebraska Act. Later the ranks of the Republicans were augmented by the disintegration of the Know-Nothing Party, or Native American Party, and during and after the CIVIL WAR by industrial elements whose welfare was compatible with the party policy, which they aided materially in shaping. The first national campaign of the party was in 1856 with JOHN CHARLES FREMONT as the Presidential nominee. Fremont's reputation was that of an explorer, and although his name possessed glamor for the popular fancy, he was not a strong political figure. The platform of 1856 denied the right of Congress or of a territorial legislature to establish slavery, coupling the latter with the polygamy of Utah as "twin relics of barbarism." It also affirmed the need of a transcontinental railway and of improving the rivers and harbors. JAMES BUCHANAN, who was elected, received less than a majority of the popular vote. Buchanan received 174 electoral votes, Fremont 114, and MILLARD FILLMORE 8; all of Fremont's support was from northern states. The struggle for Kansas, the Dred Scott Decision, 1857, and the growing animosity between the two sections brought the nation to a crisis in the Presidential election year of 1860. Southern Democrats and Whigs, threatening secession, regarded the Republican as a sectional party which if in power would govern the country for the welfare chiefly of its own section. The split in the DEMOCRATIC PARTY foreshadowed the certainty of Republican success.

The Republican Party in convention at Chicago in 1860 nominated ABRAHAM LINCOLN, originally a Whig, for President and HANNIBAL HAMLIN, a former Democrat, for Vice-President. The party in its platform again contended that slavery should be excluded from the territories, although asserting that there should be no interference with the institution in states where it already existed; advocated a Homestead Act and a protective tariff. The Republicans were opposed by the two sections of the Democratic Party and a Constitutional Union Party composed of remnants of the old Whig and Know-Nothing parties. Lincoln, who received approximately only 40% of the popular vote, obtained 180 of the total 303 electoral votes. His election was the signal for the secession of seven southern states, beginning with South Carolina. These Confederate states were joined by four other slave states after the fall of Ft. Sumter. Under the leadership of Lincoln, the Republicans at first minimized the importance of the slavery issue and emphasized the maintenance of the Union as the cause for forcibly coercing the seceded states to return to the Union. This attitude of the Republicans was used later as propaganda to the effect that

they were the party of the Union and that the Democrats were the party of rebellion. Delicate handling of the slavery issue by the NATIONAL GOVERNMENT was necessary because of the necessity of retaining the allegiance of the border slave states. By 1862 slavery was recognized as a source of strength to the Confederate states, and beginning with the Emancipation Proclamation, 1862, measures for its abolition were taken, culminating in the 13th Amendment, 1865, which ended it. Other measures were pushed by the Republicans with the expressed purpose of successfully prosecuting the war or of retaining the support of disinterested sections which persisted after the war and profoundly affected the nation. Among these were a National Banking Act, the subsidization of a railroad to the Pacific Coast, a high tariff and a Homestead Act. In the campaign of 1864, the Republican Party to strengthen itself with the northern war-Democrats, changed its name to National Union Party. As a further appeal to the Democrats, the nominee for the Vice-Presidency was ANDREW JOHNSON, a Tennessee Democrat. The platform defended Republican policies and declared the necessity of maintaining the Union. Lincoln was again the Presidential nominee, and aided by the apparent success of the Union armies in the fall he was reelected by an electoral vote of 212 to 21, although his popular majority was only 2,213,665 votes to 1,802,237 for GEORGE B. McCLELLAN, the Democratic nominee. The assassination of Lincoln, Apr. 14, 1865, brought Andrew Johnson to the Presidency during what was the most troubled period in the nation's history. The Government was confronted with the problem of restoring a nation, which had been at war for four years, to peace-time conditions and of reconstructing the war-torn rebellious states. From the outset a group of implacable Republicans, led by THADDEUS STEVENS in the House and by CHARLES SUMNER in the Senate insisted upon a severe policy of reconstruction. This was unacceptable to Johnson who believed a program of vindictiveness to be unwise. Many of the harshest measures of the Republican Party were passed over Johnson's veto and the quarrel culminated in the attempt to impeach the President in 1868.

Republican Domination. The disorders attending the reconstruction governments in the South, which were controlled by the Republicans, solidified the opposition of those states in the Democratic Party, although the "Solid South," because of military and political interference, was not manifested in Presidential elections until after the administration of RUTHERFORD HAYES, 1877-81. ULYSSES S. GRANT, the military hero of the war, was elected President by the Republicans in 1868 against the Democrat, HORATIO SEYMOUR, and again in 1872 against the coalition candidate of the Liberal Republicans and the Democrats, HORACE GREELEY. The harshness of Republican policies in the South and the many scandals which were disclosed during Grant's second administration formed a strong body of opposition to continued Republican control. The disputed election in 1876 of Hayes over the

Democratic candidate, SAMUEL J. TILDEN, continued to be an unanswerable controversial topic. An electoral commission composed of five senators, five representatives and five justices of the Supreme Court decided the issue and awarded all of the disputed votes to Hayes, the Republican, by a strictly partisan vote of eight to seven. If one of the disputed electoral votes of South Carolina, Florida and Louisiana and one Oregon vote had been awarded to Tilden he would have been elected. The Democrats did, however, continue control of the House in 1876 which they had gained in 1874. Hayes, despite the protests of many Republicans, withdrew the troops from the South, and thereby ended the domination of his party in that region. His Administration, although hampered by the return of the Democrats in 1878 to control of both the House and the Senate, was considered a capable one; but disgruntled Republicans passed by him in the Republican Convention of 1880 and nominated JAMES A. GARFIELD. The abandonment of the severe reconstruction policy, the weakness of the Democratic candidate, and the association in the popular mind of prosperity with a Republican administration which was already beginning to be expressed, enabled Garfield to obtain a clear victory of 214 electoral votes to 155, although he obtained less than 10,000 more popular votes than did Hancock. CHESTER A. ARTHUR, Vice-President, succeeded Garfield as President at the latter's assassination in 1881. The tendency, which later became marked, of changing the control of Congress in the years between Presidential elections appeared again in 1882 with the changing in the House of a Republican majority of 19 to a Democratic majority of 78. Arthur conducted the affairs of his office with unexpected merit; but the strength of JAMES G. BLAINE as a potential candidate could no longer be withstood and the Republican Convention of 1884 proceeded to nominate him for the Presidency. Blaine's vulnerability lay in alleged irregularities in public office, and his opponent, GROVER CLEVELAND, was assailable on the score of his private life. In one of the bitterest of Presidential campaigns, one which involved the personalities of the candidates rather than political issues, Cleveland won, the result turning on his majority by a few thousand popular votes in New York State.

Tariff Issues. Cleveland's annual Presidential message of 1887 in which he demanded a lower tariff gave the Republicans an issue for the campaign of 1888. With BENJAMIN HARRISON as their nominee they vigorously contended that a high protective tariff was essential to American prosperity. Although Cleveland received 100,000 more popular votes than did his opponent, the electoral vote was 233 to 168 in favor of Harrison. The Republicans regarded the election as public endorsement of a high protective tariff and proceeded to draw up a new schedule of tariff duties known as the McKINLEY TARIFF ACT, thus called after the chairman of the House Committee of Ways and Means which originally drafted it. (See McKINLEY, WILLIAM.) The new tariff schedule

according to McKinley was "protective in every paragraph and American in every line and word." It was passed by both houses in 1890; but in the Senate the necessary support was obtained only by an agreement to provide helpful legislation for the silver states which was done by the Sherman Silver Purchase Act of 1890. The opponents of the Republicans predicted calamitous prices as a result of the bill, which was finally passed about a month before the Congressional election of 1890. Whereas these predictions had had no opportunity for realization their effect upon the public was a landslide which returned 235 Democrats to the House to 88 Republicans, even though McKinley was not returned.

In 1892 Republicans and Democrats in their platforms unequivocally declared themselves respectively in favor of high and low tariffs. Harrison attributed his defeat by Cleveland in 1892 to public disapproval of the tragic events of the Homestead Strike, but it would seem that a variety of causes operated to bring about the result which could be summarized as general dissatisfaction with conditions. The Republican Party lost control of the Government before the Panic of 1893, which along with subsequent depression were accredited to Democratic defects. The Republicans in 1894 achieved the now common phenomenon of overturning the control of Congress at the so-called midterm election. They regained control of both the Senate and the House, the latter by a majority of 248 to 104. The campaign of 1896, which superficially was fought on the issue of "hard or soft" money, was more deeply a struggle between two complex social-economic groups, each with a Governmental philosophy which could not be equally beneficial to both of the contending groups.

Gold Standard. The problem of currency inflation which began during the Civil War had been a subject of controversy ever since. The faction which favored generous issues of greenbacks or fiat currency absorbed into their ranks the silverites who were not interested in the discussion as an academic problem but were desirous of a market for silver. The Bland-Allison Act of 1878 which provided for the purchase monthly of \$2,000,000 to \$4,000,000 worth of silver by the Secretary of the Treasury for currency purposes and had been passed over Hayes's veto by a Democratic House and a Republican Senate was not a partisan measure. The Sherman Silver Purchase Act of 1890 had been passed by a Government wholly in control of the Republicans and had been repealed in 1893 by a wholly Democratic Government. Nevertheless, the Republican Party in 1896 in its platform stood squarely on a gold standard, an attitude which received the endorsement of its Presidential nominee, William McKinley, although his previous record showed him to be in favor of bi-metallism. The monetary issue was squarely joined when the Democratic Convention, under the spell of Bryan's (see BRYAN, WILLIAM J.) magic oratory, declared in its platform that the party favored free and unlimited coinage of silver on a basis of 16 to 1 and named him

as Presidential nominee. The campaign, which was a spectacular one, resulted in a complete victory for the Republicans, McKinley obtaining 271 electoral votes to Bryan's 176. The popular vote was 7,111,607 for McKinley to 6,509,052 for Bryan. The declaration of the "gold standard" of the Republican platform was not legalized until Mar. 14, 1900, since the presence of Silverites in the Senate until their defeat in the election of 1898 prevented any previous action. The DINGLEY TARIFF ACT which revised the rates upward had already been prepared during the latter half of Cleveland's administration when the Republicans controlled both houses and with the advent of McKinley was rushed through Congress to receive his signature July 24, 1897.

The years of industrial prosperity which accompanied McKinley's administration were hailed by Republicans as the result of their sound national policies. The successful war with Spain gratified the patriotic pride of the nation, and the cession of Spanish territories to the United States led the Democratic Convention of 1900 to declare that "the burning issue of imperialism" was "the paramount issue of the campaign." The second Presidential campaign between Bryan and McKinley ended as had the first in a convincing victory for the latter. McKinley's running mate was THEODORE ROOSEVELT, who was named for various reasons, mostly the hostility of powerful Republican politicians, and through no desire of his own. His accession to the Presidency in 1901 after the third assassination of a President within 36 years was viewed with apprehension by big-business interests because of his reputation as a reformer. Roosevelt at first acted cautiously, since he believed that whereas the evils of big business should be eliminated there were certain benefits of large scale production which should be retained. In 1904 Roosevelt defeated ALTON B. PARKER, the Democratic nominee, by the overwhelming majority of 7,628,785 to 5,084,442 with an electoral count of 336 to 140. Thus assured of public confidence, during his second Administration he boldly and energetically promoted the passage of a series of acts whose purpose was to supplement and to strengthen the principles of the earlier Interstate Commerce Act, 1887, and the Sherman Anti-Trust Act, 1890. WILLIAM H. TAFT, his Secretary of War, was virtually named by Roosevelt as his successor.

Progressive Revolt. Taft's administration was condemned by liberal Republicans as reactionary. Roosevelt, himself, expressed his disappointment with the policies of his own choice, and outlining a program of needed reforms, he entered the primary elections of 1912, so that before the Republican National Convention he had a large block of pledged votes. The conservative elements in the Republican Party controlled the preliminary machinery of the convention, and they exercised this control in a way which was injurious to Roosevelt's chances for the nomination and favorable to Taft's. The bolt of Roosevelt and his followers to the Progressive Republican Party

split the strength of the Republican Party and enabled WOODROW WILSON to gain an easy victory with a popular minority, but with 435 electoral votes to 88 for Roosevelt and eight for Taft. The Progressive Party disintegrated after it again tendered the nomination to Roosevelt in 1916. He refused it and thus announced his return to the ranks of the Republican Party.

The Republicans in 1916 nominated CHARLES EVANS HUGHES, Supreme Court Justice and former reform governor of New York, for the Presidency. There were still disaffected elements within the party, which condition coupled with a badly managed campaign contributed to the defeat of Hughes by the close margin of 277 electoral votes to 254. Partisan politics in Congress disappeared during the period of the war with Germany until President Wilson, prior to the Congressional elections of 1918, in a public letter requested the return of a Democratic majority to both the Senate and the House of Representatives.

Landslide After World War. Republicans everywhere protested sharply against what they characterized as Wilson's unfair action, and the election returns gave them a majority of 41 in the House and control of the Senate with the aid of the La Follette (see LA FOLLETTE, ROBERT M.) group. When the Versailles Treaty was submitted to the Senate for ratification a majority of the Republican senators refused to approve it without reservations. Wilson insisted upon ratification without the reservations or not at all, with the result that the treaty was rejected. Wilson made membership in the League the issue of the 1920 campaign. The Republicans in their platform endorsed the defeat of the Versailles Treaty and promised that the party would "fulfil our world obligations without sacrifice to our national independence." The platform further denounced the Administration as being as unprepared for peace as it had been for war. The three leading candidates for the Republican nomination, LEONARD WOOD, FRANK O. LOWDEN and HIRAM JOHNSON, blocked one another with the result that Senator WARREN G. HARDING of Ohio was nominated as a compromise candidate. CALVIN COOLIDGE was nominated for the Vice-Presidency. Harding, who provided the campaign slogan of "back to normalcy," was elected by the then remarkable popular majority of 16,152,200 votes to 9,147,353 for his opponent JAMES M. COX and an electoral majority of 404 to 127. Coolidge succeeded Harding upon the latter's death in Aug., 1923. Coolidge, a taciturn man, attained remarkable popularity and also a reputation for sound judgment. Domestic issues were uppermost in the campaign of 1924, in which the Republican Party, aided by dissension in the Democratic ranks and a return of moderate prosperity, scored another sweeping victory with Coolidge as the Presidential nominee.

The unprecedented prosperity of the years of Coolidge's second Administration undoubtedly strengthened the already widespread belief that national prosperity was coupled with a Republican Administration.

In 1928 Coolidge issued his famous declaration, "I do not choose to run," and the Republican National Convention nominated HERBERT HOOVER, a talented engineer, former director of Belgian Relief, and Secretary of Commerce under Harding and Coolidge. Hoover benefited by the public confidence of an undreamed prosperity under a brilliant business man and the many factors which detached the hitherto "Solid South" from the Democratic candidate. Hoover received 21,409,215 votes to 15,042,366 for ALFRED E. SMITH with an electoral majority of 444 to 87. The most remarkable feature of the victory was Hoover's success in carrying not only "the border states" of Tennessee, Kentucky, Oklahoma and Missouri but also those of Virginia, North Carolina, Florida and Texas which gave their electoral vote to a Republican for the first time since the removal of Reconstruction control. The Republicans also gained solid majorities in the two houses of Congress. Severe business depression gripped the United States in 1929 as it did other parts of the world. Such conditions always react unfavorably to the party in power, and the rule was sharply illustrated in the mid-term Congressional election of 1930. The Republican majority in the House was reduced from 103 to a possible two, and before the House convened in Dec. 1931 the majority had disappeared entirely with the result that a Democratic majority organized the House. When the Senate convened in Dec. 1931, although the Republicans had exactly half of the membership, among their ranks were many so-called "insurgent Republicans" who could not be relied upon to support party policies. In June 1932 the Republican Party renominated Hoover for President and Curtis for Vice-President. Both were overwhelmingly defeated. S. McK.

BIBLIOGRAPHY.—A. D. Morse, *Parties and Party Leaders*, 1923; E. E. Robinson, *The Evolution of American Political Parties*, 1924; K. H. Porter, ed., *National Party Platforms, 1840-1924*, 1924; W. S. Myers, *The Republican Party*, 1928.

REPUDIATION, in finance the renunciation or disavowal of a contract or obligation. The term is most frequently used in politics in connection with the refusal of a state or municipality to pay its just debts. It may also be used in connection with treaty obligations. The term carries with it the implication that the obligation denied is in reality a just claim upon the state and the further implication that the state is merely taking advantage of that rule of law which provides that a sovereign state cannot be sued by an individual save with its own consent.

REQUIEM, in music, a Mass for the dead, taking its name from the first word of the Introitus which begins *Requiem aeternam dona eis* (Grant them eternal rest). In the Roman Catholic Church it is regularly sung each year on All Souls' Day in commemoration of the faithful departed; special performances for individuals are also common. It divides into several sections: Introitus, Kyrie, Absolve Domine, Dies Irae, Domine Jesu Christi, Sanctus, Benedictus, Agnus Dei, Communio, and Lux Aeterna. The Responsorium and Lectio are sometimes added. Many of the world's foremost composers have com-

posed musical settings of this liturgical drama, the most famous of which are those by Mozart, Cherubini, Berlioz, and Verdi.

REQUISITION, in warfare, goods or articles of a civilian population taken from the people for the benefit of an army. It may also include money levied for special purposes, generally called contributions. The right to levy requisitions is generally admitted and is supposed to be limited to the necessities of the occupying army. The commander must authorize them in writing, and receipts must be given in exchange. They must be limited to the resources of the country and must not involve the population in the war against their own side.

REREDOS, or altarpiece, generally the wall of stone or wood, or the screen, placed behind the altar. The reredos usually contains niches and buttresses on which statuettes are placed, and provides panels suitable for painting sacred figures, or representations of the Passion. The first reredos was used in the 12th century. A celebrated example is the reredos of carved ivory exhibited in the Cluny Museum, Paris. In later times the reredos was elaborated, in some instances being constructed nearly to the height of the ceiling. Altar and reredos are occasionally made in one piece.

RESACA, BATTLE OF, May 14-15, 1864, in the CIVIL WAR, the opening engagement in Gen. Sherman's march to Atlanta. On May 3 Sherman with about 100,000 Federal troops marched from Chattanooga. The opposing army, 65,000 Confederates under Gen. Joseph E. Johnston, retreated from Dalton, its base in northern Georgia, to Resaca. On May 14 an advance detachment of Sherman's army attacked, but was repulsed with heavy losses. Attempting to press the attack Johnston abandoned a strong position. His army occupied the lost ground. Several assaults on the following day directed at the Union line were unsuccessful, and Johnston's army withdrew. The Federal loss was about 2,000, twice the Confederate casualties.

RESACA DE LA PALMA, BATTLE OF, May 9, 1846, an engagement of the MEXICAN WAR, between a Mexican force of 7,000 under Gen. Arista and 2,000 American troops under ZACHARY TAYLOR. After the defeat of Palo Alto, Arista fell back to Resaca de la Palma, a low ridge commanding the road to Matamoros, and during the night of May 8-9 was reinforced by about 2,000 infantry. When Taylor arrived before the Mexican position, a duel of artillery ensued which held the Americans in check until Taylor despatched Capt. May with a squadron of dragoons. He gained the ridge in a gallant charge and captured the Mexican artillery. The Mexicans retired in panic. More were drowned while attempting to swim the Rio Grande than were killed in the battle. The American loss was 36 killed and 70 wounded; the Mexican casualties numbered 400.

RESEARCH, work done in solving or attempting to solve an unanswered question of material fact. It involves original work, and is essentially the collection of data that are not a part of current knowledge.

Research may be conducted in the pure or applied sciences or in engineering, in which cases new facts are obtained by technical experimentation; in the field of the arts, which involves the study of old works of art or literature; in the field of the natural sciences, such as geology, which involves the study of naturally occurring phenomena; or it may be statistical research, which is a compilation of existing data from varied sources.

The idea of research may very well be illustrated by the story of GALILEO. One of the live questions of his day was, "Does a large body fall faster than a small one?" Galileo's reply was, "Why don't you try it?" Acting on his own suggestion, he carried a large and a small stone to the top of the Leaning Tower of Pisa and dropped them simultaneously. His colleagues, standing around the base of the tower, heard them strike the ground simultaneously. There could be no refutation of such an answer and Galileo had ushered in a new age, that of research and investigation. He had replaced guess-work and logical argumentation by experimental fact. If for no other reason, this idea alone should make Galileo's name preeminent.

There were and still are many unsolved problems in and about the South Pole. Rear Admiral Byrd solved some of these problems on his trip there, and in doing so, added the knowledge of civilized peoples. In other words, his expedition did research work.

Through research, all the advances in civilization have been made throughout the ages. Every step which primitive man made to better his condition was made by means of research, even though at times this research was itself of the most primitive type. This conception of the value of research should be the mental attitude of all people, for civilization progresses only to the extent that research method is applied to all fields of knowledge and activities.

Manufacturing establishments have awakened to the value of research in their plants. Many of the large concerns maintain research departments and their value is demonstrated by the fact that the research division pays dividends just as any other division in the plant. See INDUSTRIAL RESEARCH.

S. R. W.

RESEARCH, INDUSTRIAL. See INDUSTRIAL RESEARCH.

RESERVE, MILITARY, troops and material held back to reinforce units already engaged or to meet unforeseen emergencies. A general or strategic reserve consists of corps and divisions held by a commander-in-chief to meet a great contingency. General Headquarters (G.H.Q.) reserve consists essentially of tanks, artillery, aviation, chemical troops and engineers. An army ordinarily holds one or more divisions in reserve. A corps with a limited objective holds only a small reserve. If it is making a deep advance, it keeps one or more divisions in reserve. The reserves of brigades, regiments and battalions vary from one-eighth to one-third of the strength of

the unit. In defense, higher commanders must have reserves to meet unforeseen emergencies and for counter offensive action. In offense and counter offense, they should not hesitate to use their last reserve.

S C. V.

RESERVE OFFICERS TRAINING CORPS CAMPS, organizations to provide facilities for the military training of the Reserve Officers Training Corps. The camps are equipped with barracks, mess halls, medical and supply stations and the like, as is a regular army camp. Each camp includes enough territory to permit of military maneuvers and practice in firing. The material used at these camps usually belongs to the regular army. Cadets of the Reserve Officers Training Corps spend six weeks at the Reserve Officers Training Corps camps prior to receiving their commission.

RESERVES. See ORGANIZED RESERVES; MILITARY POLICY; NAVAL RESERVES.

RESERVES, BANK. See BANK RESERVES.

RESERVOIRS. Storage of surface waters for supplying cities and towns is necessary where wells, rivers and lakes of sufficient capacity are not available. Artificial lakes formed by building DAMS across water courses for this purpose are called "impounding" reservoirs. Run-off from the watershed must be carefully investigated to make sure that the reservoirs will contain enough water to supply the community through the longest possible dry season. They are usually designed to hold at least one year's supply. See also WATER SUPPLY.

Elevated basins holding a limited quantity of water and connected with distribution systems are called "distributing" reservoirs. They also serve to maintain steady pressures in the mains and a fairly uniform head on the pumps. Their capacity may range from only a few hours' supply to enough for several days.

E. E. W.

See A. R. Binnie, *Rainfall Reservoirs and Water Supply*.

RESHT, a city of Persia and capital of the Gilan province situated on Siah Rud, about 150 mi. northwest of Tehran. The city is the nucleus of a number of important routes of the Gilan province. Surrounded by extensive rice fields, Resht is also the center of a large silk trade and manufactures shawls and carpets. It has many spacious bazaars, warehouses, shops and the ruins of a palace. The bazaars were partly burned in 1920 when the Bolsheviks invaded the city. Unlike many Persian cities, Resht has cobble paved streets, a sewerage system, is illuminated by electricity and has direct telephone communications with several cities of the country. Est. pop. 1930, 80,000.

RESINS, NATURAL. Resin is the term applied to a widely used class of non-crystalline solids of (with the exception of shellac) vegetable origin. They are generally vitreous, fusible by heat, insoluble in water, soluble in alcohol and usually in aqueous solutions of alkalis. They burn with a smoky flame, frequently emitting an aromatic odor. Chemically, they are oxi-

vegetable families produce resin secretions which may flow normally from resin ducts or cavities, or which may be induced to flow by wounding with axe, knife or some natural agency. The resin comes to the surface as a balsam or turpentine and there loses part of the volatile constituents and oxidizes to the solid product. Such so-called "recent" resins are relatively soft and are more readily soluble in alcohol. In this class is ordinary ROSIN (or colophony) derived from the long-leaf yellow pine, mastic, sandarach, and the softer copals such as damar, Manilla, Singapore and related varieties. Some resins have become fossilized through process of AUTO-OXIDATION and POLYMERIZATION continued through long eras and are prized for their hardness and brilliancy. A well-known example of this class is amber. Others, used to a considerable extent in the varnish industry to give hardness and luster to oil varnishes, are the insoluble copals, such as kauri from New Zealand, and the copals known as Congo, Sierre Leone, Benguela, Angola, etc., from Africa (see VARNISH-MAKING). Widely used as resin is Lac (sticklac and shellac) which is not of vegetable origin, but the secretion of the lac insect found on a number of Indian trees.

R. J. M.

BIBLIOGRAPHY—Barry, Drummond and Morrell, *Chemistry of Natural and Synthetic Resins*, New York, 1926.

RESINS, SYNTHETIC, organic substances produced through chemical interaction, condensation, and polymerization, which in appearance and physical properties are much like natural resins. Resins thus synthetically produced may be broadly classified as of

1. the *heat-hardening* type
and

2. the *non-heat-hardening* type.

The most important of the heat-hardening type are the phenol-aldehyde products brought out by the chemist LEO HENDRIK BAEKELAND in 1909 under the trade name Bakelite. These synthetic resins, prepared by reacting PHENOL (carbolic acid) and FORMALDEHYDE were the first to become of industrial importance. Such synthetic resins are extensively employed as plastic materials and as protective coatings. The heat-hardened resins are far superior to any natural resinous substance in hardness, strength and resistance to deteriorating agents generally. Urea and formaldehyde give a light-colored, heat-hardening resin. It is employed in the molded product, Beetle, and is characterized by toughness and light color effect. Vinyl resins and Styrol resins, both non-heat-hardening and light in color, are finding use as plastics where resistance to heat is not important.

Cumaron resin, obtained from coal tar naphtha; ester gum, obtained by chemically combining rosin and glycerine; synthetic resin and natural resin combinations, such as Abertol, all find use in oleo-resin varnishes. Superior and of rapidly growing importance in the production of oleo-resin varnishes are certain oil-soluble phenol-aldehyde resins. Modified phthalic anhydride-glycerol or Glyptal, type resins, particularly their combinations with oil acids, find large use in the field of protective coatings.

L. V. R.

RESISTANCE, electrical, that physical property of a conductor which opposes the flow of current. Since current is a movement of electrons along a conductor, resistance is the interference of the molecules with the electrons, which generate heat and causes the temperature of the conductor to rise. This characteristic is employed in electric toasters and other electric heating devices to convert electrical energy into heat energy. In power transmission it produces line losses that are manifest as a drop in potential.

The value of resistance is given by Ohm's Law, $E = IR$ or $R = \frac{E}{I}$, where R is the resistance in ohms, E the potential drop in volts between the terminals of the conductor and I the current in amperes flowing in the conductor. By this definition the ohm is that value of resistance which produces a potential difference of one volt when a current of one ampere is flowing.

Resistance varies with different materials and with temperatures, usually increasing as the temperature rises. However, the resistance of a given conductor at a given temperature is proportional to its length and inversely proportional to its cross-sectional area. Therefore, specific resistance, or resistivity, is defined by ρ in the equation

$$R = \frac{\rho l}{A} \text{ or } \rho = \frac{RA}{l}$$

where R is the resistance in ohms, l the length in feet and A the cross-sectional area in circular mils.

X.

Resistance Measurements are usually made either by an **AMMETER** and **VOLTMETER** or by a bridge circuit (see **WHEATSTONE BRIDGE**). In the first method a current is passed through the resistance, and by means of an ammeter and a voltmeter, simultaneous readings are taken of the current and the potential difference across the resistance. Ohm's Law states that the voltage, E , equals the product of the resistance, R , and the current, I , or $E = IR$. Thus, the voltage divided by the current is the resistance in ohms. In this method it is necessary to correct the reading of one instrument because of the presence of the other. Thus, if the voltmeter is connected directly across the resistance, the ammeter will read the sum of the current in the resistance and the current in the voltmeter, whereas only the current in the resistance is desired.

Bridge methods are very much more accurate and convenient to use. For most work the Wheatstone bridge is used; low-resistance values are preferably measured on the Kelvin bridge. In both of these bridges, a **GALVANOMETER** is used as a current detector, and the object is to adjust the ratio arms of the bridge and the balancing arm until the galvanometer reaches a zero deflection. The value of the unknown resistance is readily computed from the settings of the bridge resistors.

The device known as the ohmmeter is used in a

great many industrial measurements of resistance. It is really a Wheatstone bridge built, usually, with a self-contained galvanometer and battery and with the balancing arm calibrated to indicate directly the value of the unknown resistance in ohms. It has the advantages of speed and portability, but is not suitable for work where considerable accuracy is desired.

Where resistances are used in **ALTERNATING CURRENT** circuits, special measurements are often necessary. A direct current flowing through a conductor is uniformly distributed over the cross section of the conductor, but an alternating current through the same conductor is not uniformly distributed. The current density is greater at the outer edges than at the inside of the conductor, giving rise to the so-called "skin effect." The apparent resistance under these conditions is greater than the resistance to direct current, and is known as the *effective resistance*. In order to measure it properly, the measuring current must be of the same frequency as that in the circuit where the resistance is used. Various types of alternating current bridges are available for such measurements. The standard of comparison used must, of course, be calibrated at the proper frequency. Instead of the ordinary galvanometer, either a vibration galvanometer or, if high frequencies are involved, a telephone receiver, is used to detect a balance. See also **ELECTRICAL INSTRUMENTS**. W. H. T.

RESISTANCE THERMOMETER. The electrical resistance of a wire increases with the temperature. Hence, a coil of wire, with proper connections, mounted in a protecting tube of porcelain, glass or metal can be used, with a suitable **WHEATSTONE BRIDGE**, as a thermometer. Except for its high cost, pure platinum wire is the most satisfactory material for a resistance thermometer. With this type of thermometer, measurements can be made accurately from -200°C . to $1,200^{\circ}\text{C}$. The resistance thermometer is also particularly well adapted to measuring accurately comparatively small differences in temperature, as in **CALORIMETRY**. For industrial work, nickel resistance thermometers are often used, but their range is limited. Although the details of construction, both of the thermometer and of the Wheatstone bridge, are quite intricate, portable indicators have been devised with which direct readings of temperature can be taken very easily. Some instruments record continuously the indications of one or more resistance thermometers. Like the **THERMOCOUPLE**, the resistance thermometer can be installed to indicate temperatures at remote points. See also **THERMOMETRY**. W. W. S.

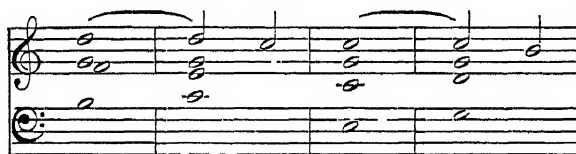
RESISTENCIA, a city of Argentina, situated about 950 mi. west of Buenos Aires. It is the only city of importance in a large territory, mainly an uncultivated jungle, and is an important trading center and a military post. Oil in considerable quantities has been located nearby, but the industry is not developed. The Chaco Boreal, a disputed territory between Bolivia and Paraguay, lies nearby. Est. pop. 1930, 35,000.

RESISTIVITY, the resistance of a portion of a substance having unit length and unit cross-section. Generally, it is the resistance of a portion one centimeter long and one square centimeter in cross-section. In engineering work, resistivity is defined in terms of the mil-foot, i.e., a CONDUCTOR one foot long and one circular mil in cross-section (a mil is $1/1,000$ in. and a circular mil is the area of a circle one mil in diameter). Expressed in these units, the resistivity of copper, one of the best conductors, is 10.4 ohms per mil-foot. The resistivity of materials ranked as good conductors is low; that of poor conductors is relatively high. Thus, the resistivity of nichrome, a high-resistance alloy, is more than 50 times that of copper.

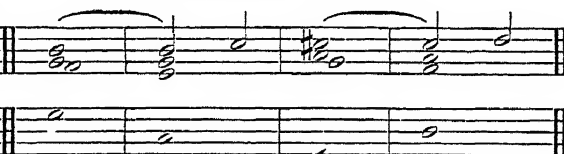
The resistivity of most materials varies with the temperature. The percentage of change corresponding to a change of one degree in temperature is called the *temperature coefficient* of resistance. For all pure metals, it is positive and practically the same, its value being approximately 4% per degree centigrade. Materials like carbon and glass have negative temperature coefficients, and certain alloys, compounded with this result in view, have temperature coefficients practically equal to zero. See also RESISTANCE. L. B. S.

RESOLUTION, in music, the progression from a dissonance to a consonance, the dissonance usually being caused by a SUSPENSION. A suspended tone resolves or passes into a concord, and this motion is called a resolution. A resolution may be either upward or downward, but is usually the latter. The following illustration sets forth the general principle:

Resolution Downward



Resolution Upward



RESOLVING POWER, the capacity of an optical instrument to show small details, particularly to show as separate two points of light close together. In all OPTICAL INSTRUMENTS, it is determined by the phenomenon of DIFFRACTION. Because of the diffraction of LIGHT passing through a LENS or circular aperture, the image of a point source of light is not a point but a bright disc of finite size, surrounded by alternate dark and bright rings. Similarly, when light passes through a slit, the image of the slit is fringed on either side with alternate dark and light bands.

It has been found that in the case of a TELESCOPE two stars can be resolved, i.e., observed to be distinct sources, when the center of the disc of the one falls upon the first dark ring of the other, and the theory shows that the angle subtended at the object glass by

the two stars when this condition obtains is $\frac{1.22 \lambda}{D}$

where λ is the wave-length of the light and D is the diameter of the object glass. This is known as the resolving power of the telescope and is independent

of the focal length. For the largest refracting telescope, that at the Yerkes Observatory, the resolving power is about $\frac{1}{8}''$ of arc. The resolving power of the eye is between one and two minutes of arc.

If a SPECTRUM be produced by means of a DIFFRACTION GRATING or PRISM, and this spectrum contains two lines so close together that they partly overlap, it can be shown that they can just be recognized as separate when the central bright part of the image of the one is on the first dark band of the other; if they are closer than this, they appear as a single line. For both prisms and gratings, the resolving power for any given wave-length is measured by the ratio of that wave-length to the least difference in wave-length

which can be detected there, i.e., by $\frac{\lambda}{\delta \lambda}$. For the

prism, the resolving power is $t \frac{\partial n}{\partial \lambda}$, where t is the

length of the base of the prism, and $\frac{\partial n}{\partial \lambda}$ is the rate of

change of the index of refraction with wave length, which depends upon the kind of glass used. For the grating, the resolving power is Nn , where N is the total number of rulings in the grating and n is the order of the spectrum observed.

In a MICROSCOPE, the resolving power, called the *numerical aperture*, is equal to $n \sin U$, where U is the angle of the most oblique ray which can enter the microscope and n is the index of refraction of the medium in which the angle is measured. T. S.

RESONANCE, ELECTRICAL, the conditions holding in a circuit when CAPACITY and INDUCTANCE

balance one another, the resistance determining and limiting the current. The current which surges into and out of a CONDENSER connected to a source of alternating electromotive force depends upon the capacity of the condenser, the resistance of the circuit and the magnitude and FREQUENCY of the electromotive force. If other factors remain the same, the current is proportional to the frequency, approaching zero for very low frequencies and rising toward a maximum value for very high frequencies. In the case of an INDUCTION COIL connected to a source of alternating electromotive force, the current depends upon the inductance of the coil, the resistance of the circuit and the magnitude and frequency of the electromotive force. In such a circuit, if the other factors remain the same, the current is inversely proportional to the frequency. It approaches a maximum value for low frequencies, and a zero value for very high frequencies.

When a condenser and an induction coil are connected in series and an alternating electromotive force

is impressed upon the circuit, the current increases or decreases with the frequency depending upon the predominance of the capacity effect or that of the inductance. It reaches a maximum value, limited by the resistance, at the particular value of the frequency for which the capacity and inductance effects are equal and balance each other.

In the series circuit described, the current at resonance is a maximum. In a parallel circuit having capacitance in one branch and inductance in the other, a somewhat similar effect is produced; but in this case, at resonance the current flowing into and out of the branched circuit reaches its minimum value, although the current in each of the branches may be very large. Under these conditions the branched circuit becomes an **OSCILLATING CIRCUIT**, and energy surges from condenser to coil and back again, the only flow of energy to the branched circuit from outside being that required to supply the heat and other losses occasioned by the oscillations.

When resonance is established in a circuit, current of some particular frequency will find less **IMPEDANCE** in the circuit than current of any other frequency. Alternating current at this same frequency would exist in the circuit if a Condenser in the circuit were charged from some external source, and then permitted to discharge through the circuit. The relation between frequency, F , inductance, L , (in henries) and capacity, C , (in farads) for resonance is approximately

$$F = \frac{1}{2\pi\sqrt{LC}}$$

See **RESONANCE POTENTIALS**. L. B. S.; L. G. H.

RESONANCE, SOUND, the condition existing in an acoustic system when the frequency of a forced vibration is equal to that of the driving vibration. The amplitude of the forced vibration is a maximum when resonance exists, and, were it possible for the effect of **Viscosity** to be zero, the amplitude would become infinite at resonance. See also **SOUND**.

RESONANCE POTENTIALS, the potentials existing, under the conditions of **RESONANCE**, between the **CONDENSER** terminals and the terminals of the **INDUCTION COIL** in an **ALTERNATING-CURRENT**, series circuit containing capacity and inductance. The effective electromotive force acting upon a condenser is large when the condenser current is large. Also, the current in a coil varies with the impressed electromotive force, so that a large current in the coil is evidence that a large electromotive force is acting upon the coil. Furthermore, the current, in the kind of circuit here considered, reaches its maximum value at resonance. It follows that, under resonance conditions in a series circuit like that described, relatively large electromotive forces exist between the condenser terminals and between the terminals of the coil. These electromotive forces may be several times as large as the total electromotive force impressed upon the series circuit. They are called resonance electromotive forces or resonance potentials.

L. B. S.

RESORCINOL, or **RESORCIN**, an aromatic chemical compound, formula $C_6H_4(OH)_2$, obtained from benzene by replacing two of its hydrogen atoms by the hydroxyl group OH ; if these are in the meta-position, i.e., separated by one hydrogen atom, resorcinol results; if they are in the para-position, or opposite each other in the benzene ring, **HYDROQUINONE** results. Resinol occurs naturally in some resins, but is made synthetically from benzene via its disulphonic acid, and appears in the form of odorless, colorless crystals, avidly soluble in water. Like phenol it has antiseptic properties and is employed in small quantities against irritations of the skin, and of the respiratory tract, but in large doses is toxic. It is used also in eye lotions (eye drops), and is a common ingredient of many preparations for the hair. The well-known coloring matter *fluorescein* is formed by the action of resorcinol and phthalic anhydride; further treatment with bromine or iodine then produces eosin and erythrosin, used in photography for staining orthochromatic plates. In general, resorcinol finds its most extensive application in the manufacture of synthetic dyes, such as azo-dyes and xanthenes. See also **DYES, SYNTHETIC**.

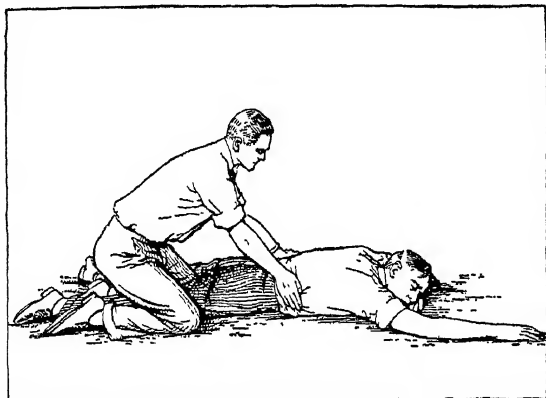
RESPIRATION, a process occurring in living protoplasm whereby stored energy is released from organic compounds so it can be utilized for various activities associated with life. It is essentially the reverse of photosynthesis, which process involves the combining of carbon dioxide and water to form sugar by means of the energy the chlorophyll of green cells absorbs from light. This latter process transforms kinetic energy of light into potential (stored) energy which is always associated with complex organic compounds, whereas respiration breaks down these compounds changing the energy back to the kinetic form. The degree to which the complex compounds are broken down varies with the conditions, needs and types of organisms. Two types of respiration are recognized—aerobic involving free oxygen, and anaerobic, occurring in the absence of free oxygen. During aerobic respiration oxygen is absorbed and organic compounds, usually carbohydrates, are oxidized and reduced to carbon dioxide and water with the release of energy. There is probably a series of changes occurring in complex compounds before this final stage is reached and some energy is liberated at every step in the process. This is the type of respiration normally going on in animals and plants. If the oxygen supply is cut off, then anaerobic respiration occurs. In fact, some organisms live best under anaerobic conditions. *Bacillus tetanus*, the bacterium which causes blood poisoning in animals, for example, thrives only under anaerobic conditions. There is great similarity between fermentation and anaerobic respiration. The essential thing for the organism in either type of respiration is the release of energy from the organic compound.

P. W. Z.

RESPIRATION, ARTIFICIAL, the maintenance of breathing movements in the apparently dead, by means of mechanical methods, is accomplished in

several ways. Though the Marshall Hall, Silvester, and Howard methods were at first used, the one now uniformly accepted as the most efficient is the Schaefer method.

In the Schaefer method, the patient is laid face downward with the head turned to the side. The operator kneels astride of the patient's loins, and fac-

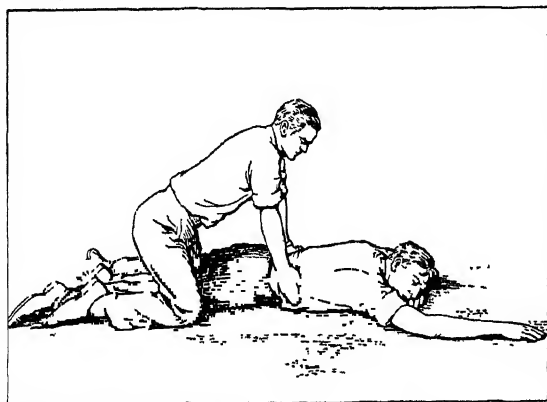


COURTESY AMERICAN RED CROSS

FIG. 1 PRONE PRESSURE METHOD, ARTIFICIAL RESPIRATION

A variation of the Schaefer method for use in apparent death from water, gas, smoke or electric contact. While waiting for the physician to arrive, lay the patient on his belly, one arm extended directly overhead, the other arm bent at elbow and with the face turned outward and resting on hand or forearm, so that the nose and mouth are free for breathing. Kneel straddling the patient's thighs with your knees placed at such a distance from the hip bones as will allow you to assume the position shown above. Place the palms of the hands on the small of the back with fingers resting on the ribs, the little finger just touching the lowest rib, with the thumb and fingers in a natural position, and the tips of the fingers just out of sight (See Fig. 2)

ing the latter's head. The operator's hands, widely open, are applied over the lower portion of the back of the patient's thorax. The operator leans forward, pressing his weight firmly upon the patient, a move-



COURTESY AMERICAN RED CROSS

FIG. 2. SECOND POSITION, PRONE PRESSURE METHOD

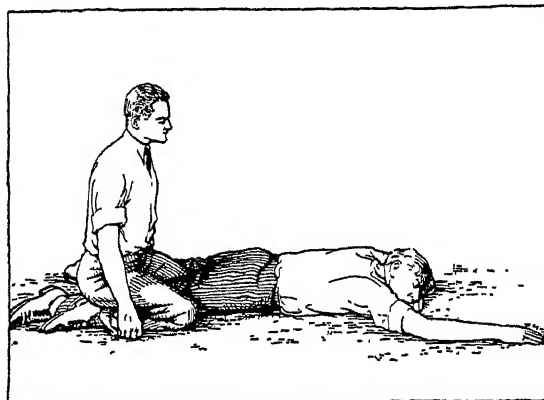
With arms held straight swing forward slowly, so that the weight of your body is gradually brought to bear upon the patient. The shoulder should be directly over the heel of the hand at the end of the forward swing. (See above.) Do not bend your elbows. This operation should take about two seconds. (See Fig. 3.)

ment equivalent to emptying the lungs of air. The operator then leans back, relaxing the pressure, so that the air rushes into the lungs with an audible gasp. This is repeated at the rate of about fifteen times the minute, which may be easily estimated as it is the normal breathing rate.

It is important to begin artificial respiration as soon as possible, as the chance of saving the life of the subject depends upon the margin of time between the cessation of respiration and of the heart beat. Persistence cannot be overemphasized, as persons have frequently been restored to life after hours of effort. This method may be used for drowning, electrical shock, gas asphyxiation or strangulation.

Certain mechanical devices, as the Pulmotor and the Drinker respirator, have been devised. The Pulmotor forces oxygen into the lungs and then sucks it out again, the process being continued until natural breathing is established.

The Drinker apparatus, popularly called the "iron lung," available only in the larger hospitals, is valuable



COURTESY AMERICAN RED CROSS

FIG. 3 THIRD POSITION, PRONE PRESSURE METHOD

Now immediately swing backward, so as to remove the pressure completely, as shown above. After two seconds, swing forward again. This is repeated deliberately 12 to 15 times a minute the double movement of compression and release, a complete respiration in four or five seconds. Continue artificial respiration without interruption until natural breathing is restored, if necessary, four hours or longer, or until the patient is dead.

where paralysis of the breathing mechanism requires an extended treatment. It consists of a large, airtight tank into which the patient's entire body is laid, with exception of the head. Pressure within the tank is alternately raised and lowered, which process acts in a fashion similar to the Schaefer method of respiration.

The use of oxygen mixed with 5 per cent carbon dioxide is valuable, as it supplies the necessary oxygen in concentrated form, while the respiratory center in the brain is stimulated to activity by the carbon dioxide. See also ASPHYXIA; GASES AND ATMOSPHERES, INJURIOUS. W. I. F.

RESPIRATION IN HIGHER ANIMALS. Living organisms must be supplied continuously with oxygen. Some of the lower forms of life can obtain this oxygen from chemical compounds containing fixed oxygen; but most animals are a so-called dependent upon a free and constant source of gaseous oxygen. This is particularly striking in the higher forms of animal life (air breathers) which obtain their oxygen from the surrounding atmosphere which contains approximately 20% of this gas by volume.

The water of brooks, rivers, lakes and the ocean contain in solution a variable amount of gaseous atmospheric oxygen which aquatic plants and animals extract by one device or other in order to survive. In the simple unicellular and pluricellular aquatic animals, the oxygen dissolved in the water diffuses into the cells where it is needed for the burning of food products. Combustion in the cell under the influence of oxygen is virtually synonymous with life itself, the processes by which this oxygen is utilized by the cells of a living being constituting what is known as *internal or cell respiration*.

With the increase in size and complexity of the animal, aquatic or terrestrial, the really living cells of the body become progressively farther removed from the surface of the organism where gaseous oxygen is plentiful. The bodies of the animals are encased in a shell or by scales or by an impervious skin which does not permit a ready passage of oxygen. For such reasons there were evolved devices by which oxygen, in water or in the air, could be brought to all cells of the body. Some form of circulation of a fluid was evolved to convey nutriment as well as oxygen to the cells (*see BLOOD*). There must also be developed some organ by which oxygen in the air or water would be brought in contact with the circulating body fluids. Thus arose the gills of fish and the lungs of birds, amphibia, reptiles and mammals. In the former, a constant flow of water containing oxygen comes in fairly direct contact with the blood circulating through the gills; in the latter, the blood circulating through the lungs is oxygenated constantly. In both instances, the heart propels the *aerated or oxygenated blood* to every body tissue whose individual cells remove the oxygen, giving off carbon dioxide (formed when, among other elements, carbon is oxidized), which is expelled from the body through the lungs or gills. In the blood of fish, amphibia, reptiles, birds and mammals, certain former elements suspended in the circulating fluid contain a red pigment, *hemoglobin*, which has the capacity of carrying larger quantities of oxygen to the tissues than the fluid portion of the blood itself could transport. The processes by means of which gaseous oxygen is transported past the gills and to the lungs and thence to internal tissues constitutes *external respiration*, the outward phase of which carries off the carbon dioxide and other waste products. *See also* RESPIRATORY APPARATUS; LUNGS; THORAX; TRACHEA; OXYGEN; CARBON DIOXIDE.

A. B. L.

RESPIRATION OF INJURIOUS GASES AND ATMOSPHERES. *See* GASES AND ATMOSPHERES, INJURIOUS.

RESPIRATORY APPARATUS. The cells of animal bodies get their energy by burning oxygen. This combustion produces carbon dioxide which is given off. The continuation of life of cells depends upon a constant supply of oxygen and the removal of carbon dioxide; if this accumulates in cells, they are asphyxiated. This interchange of oxygen for carbon dioxide is affected by the blood; red blood cells

combine loosely with both gases, they absorb them and give them up quickly and in large amounts; also the fluid part of the blood (plasma) dissolves large quantities of each gas. And the blood is pumped so rapidly that it makes a complete round of the circulation in less than half a minute. It goes to all the cells, carrying to them a constant supply of oxygen and removing their carbon dioxide.

The blood gets its new supplies of oxygen in the lungs, and there also it gets rid of its carbon dioxide. (*See RESPIRATION.*) The respiratory apparatus is the mechanism by which exchange of gases is effected between the blood and the air. Its function is to bring fresh air and blood together under conditions which facilitate gas exchange. Its essential parts in the human body are: (1) the lungs with the pulmonary blood circulation; (2) air tubes from the lungs to the surface of the body; (3) a rigid box or container for the lungs (THORAX) capable of being made larger or smaller and so of making a current of air flow back and forth. There are developed in connection with it: (a) a voice box on the air tube (LARYNX); (b) a mechanism for shutting off the airway where it is crossed by the food path (epiglottis; during swallowing it is so shut off both above and below the food path); (c) a mechanism for making the air tubes larger or smaller.

Lungs. The two lungs, right and left, lie in the thoracic cavity, one on each side of the median plane. (*See LUNGS.*) Each lung is enclosed in its own pleural sac, the root of each lung comes through the neck of the sac and connects with the vessels, etc., in the median partition. The volume of each lung, at the end of ordinary expiration, is $3\frac{1}{4}$ to $3\frac{1}{2}$ pints, the right being larger. When filled to the utmost, the volume is increased to about 5 quarts each. The air tube in each lung branches repeatedly and ends in minute air sacs like hollow leaves on a tree—a tree which looks like a mass of leaves. All are constantly distended by the atmospheric air pressure (15 pounds per square inch) after the first breath at birth. Since their walls are very elastic, each tends to contract, making pressure on the air in them but never forcing it entirely out because their force is much less than that of the air pressure. Because this elasticity is always opposing the atmospheric pressure, it results that the pressure inside the thorax but outside the lungs is always less than atmospheric pressure. This condition helps the blood circulation, for it draws the venous blood into the great veins of the thorax and so into the heart.

The air tubes of each lung unite at the root into a single stem (bronchus). The right and left bronchi join in front of the 5th thoracic vertebra to form the TRACHEA or windpipe; the latter ascends in front of the esophagus to the larynx which lies in front of the 4th, 5th and 6th cervical vertebrae, and the air way is continued through the pharynx and nose cavity to the surface.

Nose. The nasal cavity extends on each side from the opening on the face (anterior naris) back to an

opening into the upper pharynx (posterior naris). The right cavity is entirely separated from the left by a medium partition (septum). This extends from the cranium (brain-case) above down to the hard palate, and its support strengthens both of them. (*See also* NOSE.) Far reaching recesses (accessory nasal sinuses) extend from each cavity through the hollow bones of face and skull. (*See* SINUSES AND SINUSITIS) Toward the side, recesses extend far out under the eyes (maxillary sinus), others go upward on the medial side of the eyes to the forehead (frontal sinus) and others back in the skull floor (sphenoidal sinus). These recesses, being full of warmed air, protect the eyes and brain from cold, and they give some individual resonant qualities to voice, so that we can identify people by their voices. The air is warmed by the nasal mucous membrane; it is very vascular and the blood vessels lie in it like the pipes of a hot water heating system. Bony shelves project from the lateral walls into each nasal cavity. These are called conchae or turbinate bones, and, being covered by vascular mucous membrane, increase the heating surface.

The shape of the nose directs incoming air upward toward the roof of the cavity. There is situated the olfactory area which can test by smell the quality of the air. Outgoing air flows forward mainly along the nasal floor. Except in the olfactory area the cavity is lined with ciliated epithelium with mucous glands in it to keep it moist. The cilia serve as brooms sweeping toward the anterior naris dust, bacteria, or other solid particles which may get in with the air. The tear duct leads from each eye to an opening low in the lateral wall of the corresponding nasal cavity. Each posterior naris opens into the upper pharynx. Its opening (choana) is about one inch vertically by one-half inch transversely.

Pharynx. The pharynx consists of three parts: upper, middle and lower pharynx. These are behind the nose, mouth and larynx respectively, and the pharynx opens into each. The lower pharynx opens behind into the gullet or esophagus; in front, into the larynx. Thus, air-ways and food-ways cross in the middle pharynx. At the intersection, the "go-sign" is usually set for the air-ways. Only in swallowing are they set for the food-way; then barriers shut off the upper pharynx and larynx. The upper one is the soft palate, the lower one is the epiglottis. The food-ways are lined everywhere above the abdomen with stratified pavement epithelium; the air-ways by ciliated epithelium. At the intersection in the pharynx the lining is of the pavement variety.

Trachea. The trachea is a cylindrical, elastic tube lined with ciliated respiratory epithelium. It is a little over four inches long and about one-half inch in inside diameter. Half is in the neck and half in the thorax: more in the thorax as age increases. It stretches with movements of the head and on inspiration. Sixteen to twenty horseshoe-shaped rings of hyaline cartilage are disposed in its wall and prevent its collapse during inspiration. The cartilage is defi-

cient behind, where the wall is made of smooth muscle which narrows the bore somewhat by its contraction. The trachea lies immediately in front of the esophagus and divides opposite the 5th thoracic vertebra into the two bronchi, which resemble it in structure. As these extend into the lung the cartilages become smaller and irregular in shape, and disappear in bronchial branches of 1/25 inch in diameter. Beyond that wall of the bronchial twigs is muscular and may be so greatly contracted as to interfere seriously with the passage of air (asthma).

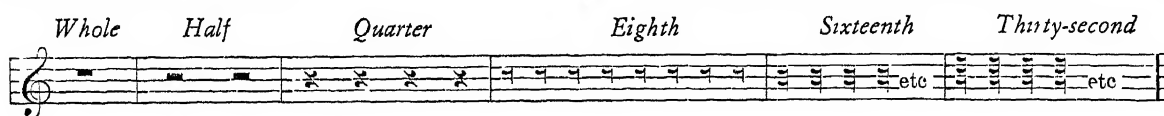
Thorax. The cavity of the THORAX is enlarged by the active movement of its walls (ribs and vertebral column) and floor (diaphragm). The diaphragm is a dome-shaped muscle. When it contracts, it becomes cone-shaped and the lower parts of the lung are forced by air pressure in them to descend around it. When the ribs are lifted they rotate outward and their anterior ends shove the breastbone forward. Thus the antero-posterior and transverse diameters of the thorax are increased. Since each rib is attached firmly in two places to the vertebral column behind, this movement involves bending the torsion of the anterior ends of the ribs near the sternum. Hence, this part of each rib is made of cartilage for a distance of several inches. Inspiration is controlled by a nerve center in the medulla. It works rhythmically and automatically, but is stimulated by carbon dioxide in the blood. Ordinary inspiration is affected by the diaphragm, by the scalene muscles which lift the upper two ribs and by the external intercostal muscles which lift the others. Forced or excessive inspiration calls in the aid of almost every muscle attached to the bony cage of the thorax or to the vertebral column near it. In such movements the vertebral column is straightened to reduce its projection into the thorax and thus an individual is slightly taller when taking in a full breath. Expiration is effected mainly by the elasticity of the lungs and of the rib cartilages. Forced expiration calls in the powerful aid of the great muscles of the abdominal walls, the diaphragm being passive. These abdominal muscles give the force used in blowing a trumpet or in the prolonged notes in singing. The quadratus lumborum muscle and the posterior inferior serrate muscles pull the lower ribs down in forced expiration, and the internal intercostals then pull all the others down toward them. (*See also* RESPIRATION IN HIGHER ANIMALS.)

Larynx. The passage of a current of air through the trachea makes the voice possible. At its upper end the LARYNX or voice box is so arranged that the air current must pass through a slit between two vocal cords which are free to vibrate. The muscles of the larynx, acting on its cartilages can approximate these cords or separate them, and make them tense or lax, thus producing sounds of various kinds. The vocal cords are elastic and tough. There are no cilia on their surface. They are tense in singing high notes. The slit between them (glottis) is made very wide and almost circular for a deep inspiration. It is closed

suddenly and involuntarily in hiccough during inspiration, and the air current striking the closed glottis makes the sound. It is closed in coughing and sneezing till forced open suddenly by accumulated pressure below it.

B. C. H. H.

REST, in music, the symbol of silence. Rests corresponding in value, or duration, with all notes in ordinary modern usage are:



RESTORATION AND POST-RESTORATION DRAMA. It has usually been assumed that the closing of the theaters in 1642 ended the theater of Charles I. It would be fairer to say that this theater died of its own sickness. When the drama begins again with the Restoration it does not sink its roots into the old theater, nor does it grow up from the soil. It is born of theories and rules, and it is nurtured on artifice. For a hundred years the best playwrights are both critics and dramatists. In many cases they are critics first and last. Two characteristics mark the drama of this time, its eager espousal of the classic rules, and, in the 18th century, its surrender to the controls of sentiment and morals. To JOHN DRYDEN (1631-1700), the first of the Restoration dramatists, the drama was never supreme as it had been with Shakespeare. In his versatility he came very near to insincerity. He is perhaps better known for his doctrine of the "heroic" play in regular verse forms than he is for any play that he himself wrote in this fashion, though of his 30 plays, *The Conquest of Granada* and *All For Love*, the last rewritten from Shakespeare's *Antony and Cleopatra*, had great popularity in his own time. By THOMAS OTWAY (1652-85), the substance of the romantic play is subjected to two contending pressures. The first was that of the classic form; the second was that cult of humanitarianism that was injecting sentiment into art and policy into thinking. *Venice Preserved*, 1682, looks forward and backward. On the one hand it is a "revenge" play; on the other it is the first of a long line of plays of social revolt.

Of all forms the one that best expresses the age and produces a self-sufficient art is Restoration comedy. Keyed to a small and exquisite audience, with a sophistication closely approaching license, this kind of play was brought from France by returning royalists. Its indispensable traits were breeding, nonchalance and wit. SIR GEORGE ETHEREGE (1634-91) introduced Sir Fopling Flutter "piping hot from Paris"; WILLIAM WYCHERLEY (1640-1715) supplied a note of masculinity and moral degradation; SIR JOHN VANBRUGH (1664-1726) was a master of invention and intrigue; GEORGE FARQUHAR (1678-1707) was a forerunner at once of Goldsmith and Sheridan, of the first in the freshness of his humanity and of the second in the freshness of his wit. But Restoration comedy reaches its height in WILLIAM CONGREVE (1670-1729). Congreve wrote only four comedies and one tragedy. His

last and best play, *The Way of the World*, was written when he was thirty. His pen was always half-disdainful. And yet he gives one masterly pictures of life sketched in brilliant talk by a society dominated by women, and concerned only with a relationship of the sexes that is all glitter and no sentiment.

In 1698 Jeremy Collier published *A Short View of the Immorality and Profaneness of the English Stage*.

With the 18th century there came a period of moral awakening, of rational balance, of coolness and policy. It was a period that was inimical to the theater and it got the plays that it deserved. JOSEPH ADDISON and RICHARD STEELE, who did their share in introducing into the age the arts of journalism, the familiar essay and the tale, both contrived to deliver a *coup de grâce* to the theater, the former in *Cato*, 1713, a frigid tragedy, the latter in a series of sentimental comedies defending the domestic virtues, and opening the tear ducts of the drama.

If dramatic literature was in the doldrums such was not the case in the great popular theater. Here things were happening that were to take the drama out of the field of literature and into the field of popular entertainment. Before 1740 Gay's *Beggar's Opera*, 1728, had become the sensation of a century, farce and pantomime had come over from France, and George Lillo in *The London Merchant, or, The History of George Barnwell*, 1731, had pointed the way to the tragedy of everyday life. Rather than for his 27 plays, HENRY FIELDING (1707-54) is perhaps better to be remembered for the fact that his satires brought down on the English theater the restricting Licensing Act of 1737. In the middle of the century Cibber, Garrick and George Colman the Elder were making new records in management of the great theaters, and Garrick was particularly distinguishing himself by correcting *Romeo and Juliet*, making a pantomime of *A Midsummer Night's Dream*, introducing topical songs into *A Winter's Tale*, and producing *Hamlet* with "alterations."

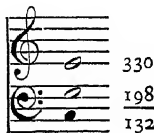
With OLIVER GOLDSMITH (1728-74) and RICHARD BRINSLEY SHERIDAN (1751-1816) one comes to the end of an era. Both men wrote drama that in form looked backward. Without knowing it, Goldsmith had in him something of the 19th century. In his knowledge of human nature, in his revulsion from affectation, in his instinctive leaning toward the "low," he showed qualities that were not understood in his own times. His *She Stoops to Conquer* is one of the great comedies of the world. And Sheridan is a later edition of Farquhar in a time when manners were being badly mixed with revolutionary interests. Brilliant like Congreve, he had better construction and more artifice. But his dialogue does not so much conceal the action as conceal the characters. Like Congreve he wrote his plays, of which *The School for Scandal*

is the chief, in his youth. With him the old drama comes to an end.
T. H. D.

BIBLIOGRAPHY—G H Nettleton, *English Drama of the Restoration and Eighteenth Century*, 1914, Allardye Nicoll, *British Drama, an Historical Survey*, 1925.

RESTRAINT OF TRADE, the prevention of the normal carrying on of business, as a result of any contract between individuals or agreement among members of a combination as against independents, to a degree deemed by the courts objectionable or "unreasonable." The exact statement of what contract or agreement is deemed illegal or as being in restraint of trade, cannot be stated in general terms. Each case stands or falls according to whether or not the restraint is considered as reasonable. For example, a contract preventing one of the parties from carrying on a certain trade throughout the entire country, and for all time, would be declared void and against public policy. But even in such a sweeping agreement, certain things as patents would not be included. The space covered and the time agreed upon are judged in restraint of trade unless a good reason is furnished. The U. S. Congress enacted in 1914 the CLAYTON ACT, which supplemented existing laws in regard to restraint of trade. See also SHERMAN ANTI-TRUST ACT.

RESULTANT TONES, a phenomenon in acoustics, discovered about 1715 by the Italian violinist and composer, Giuseppe Tartini (1692-1770), and hence often known as Tartini Tones. If two tones are sounded together a third tone, much weaker than either, is created. Its pitch is determined by the difference between the vibration rate of its tonal parents, and for this reason is known also as a difference tone. Thus, if two tones having 198 and 330 vibrations per second are sounded together, a third tone having 132 vibrations per second is created, the cause of this being that number of beats between the parent tones, as follows:



When more than two tones are sounded together the formula $R = \frac{n(n-1)}{2}$ (where R equals the number of resultant tones and n equals the number of parent tones) makes the calculation of any number of resultant tones possible. Thus, six resultant tones are produced by four parent tones since $\frac{4(4-1)}{2} = 6$.

Summational tones, produced by the sum of the vibration of parent tones, were discovered by the German scientist, Hermann Helmholtz (1821-94).

RESURRECTION PLANT, the name given to various plants which, when dry and apparently dead, come to life when exposed to moisture. Conspicuous among these is the rose of Jericho (*Anastatica hierochuntica*), a small annual of the mustard fam-

ily found in sandy deserts from Arabia and Syria to Algeria, which after flowering, rolls up into a ball with the fruits inside and is blown about by the winds. When wetted by winter rains the branches straighten out and the seeds germinate. Several mosslike selaginellas show similar characteristics, especially the so-called bird's-nest fern (*Selaginella lepidophylla*), a native of Mexico and western Texas. The dried plant, when placed in water, unfolds, often becoming green and resuming growth.

RESUSCITATION. See RESPIRATION, ARTIFICIAL.

RESZKE, EDOUARD DE (1855-1917), Polish basso, was born at Warsaw, Dec. 23, 1855. He was trained by his brother JEAN DE RESZKE, and made his début at Paris in 1876. His intense musical feeling was united to strong artistic conscientiousness, and he possessed one of the phenomenal voices of his generation. During 1890-1900 he was a leading member of the company of the Metropolitan Opera, New York. In 1906 he retired to his estate in Poland, where he died, May 25, 1917.

RESZKE, JEAN DE (1850-1925), Polish tenor, was born at Warsaw, Jan. 14, 1850. He made his operatic début, as a baritone, at Venice in 1874. Five years later he made his first appearance as a tenor in Madrid. His superb voice, faultless musical taste, dramatic power, and linguistic gifts earned him international renown on the operatic stage. He was unrivalled in the Wagnerian rôles of Walther, Tristan, and Siegfried. During 1890-1900 he appeared frequently at the Metropolitan Opera, New York. He died at Nice, Apr. 3, 1925.

RETAILING, the final step in the process of distributing merchandise to the ultimate consumer. In order to properly perform this function the retailer must select and carry a reserve supply of commodities to meet the anticipated requirements of the individual customer. For this service he is paid a margin of profit to which he is entitled.

The total annual retail trade of the United States is estimated at about 45 billion dollars distributed by the different types of retail agencies approximately as follows:

Department Stores	16 0%
Chain Stores	18 0
Mail Order Houses	3 6
Company Stores	3 0
House to House Selling	2 3
Consumer Cooperative	4
Independent Unit Stores	56.7
	<hr/>
	100.0

Changes in consumer shopping and buying habits during recent years have very greatly increased the responsibility of the retailer and have made his position more exacting. Formerly the customer looked to the store almost entirely for new ideas and new merchandise and purchased to best advantage from what was offered. Now new ideas are obtained from magazines, travel, radio, moving pictures and news-

papers; and the customer is insistent in his demand for the merchandise which he thinks to be in style. Style information is disseminated widely and quickly, so that the whole nation may be said to get the same ideas at about the same time. Standing at the point where producer and consumer meet, the retailer automatically assumes a serious responsibility in the whole scheme of distribution. It is through him that consumer demand is, or should be, interpreted and transmitted to the manufacturer and that new ideas and new merchandise reach the consumer. See also DEPARTMENT STORES; CHAIN STORES; MAIL ORDER HOUSES.

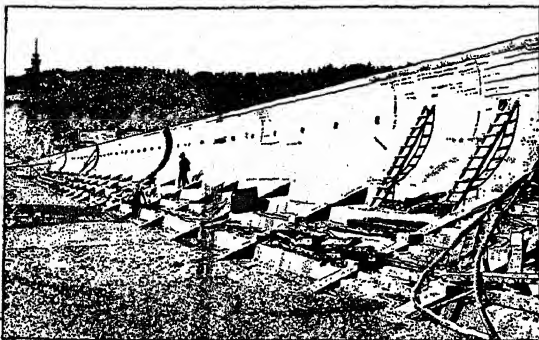
J. L. F.

RETAIL TRADE, UNITED STATES. For the first time in the history of the country the Census of 1930 presented comprehensive statistics of the retail industry of the United States. Important details concerning the retail trade of the country as a whole and also for the 10 leading states, which, in the aggregate, transacted 62% of the total retail sales of the nation, are set forth in the following table:

RETAIL TRADE, U.S., 1929

Division	No. of Stores	Net Sales \$	Sales per Capita \$	Sales per Store \$	% of Total
United States.	1,549,168	50,033,850,792	407.52	32,297	100.00
LEADING STATES:					
New York ..	189,921	7,239,632,514	575.12	38,119	14.47
Penna.	136,518	4,039,555,807	419.42	29,590	8.07
Ill.	97,074	3,687,370,356	483.23	37,985	7.37
Calif.	86,025	3,268,545,636	575.73	37,995	6.53
Ohio	84,042	3,056,748,364	459.89	36,372	6.11
Mich.	56,290	2,235,570,860	461.67	39,715	4.47
Texas	67,258	2,074,164,554	356.10	30,839	4.15
Mass.	53,855	2,058,887,788	484.49	28,230	4.12
N. J.	60,203	1,851,405,393	458.12	30,753	3.70
Mo.	47,216	1,490,146,846	410.58	31,560	2.98

RETAINING WALLS, barriers similar to DAMS, which are built to retain earth and loose rock, or to protect friable rock faces. They are built of stone



CONCRETE SEA RETAINING WALL
North Beach, San Francisco, Calif.

masonry, or of concrete with a base thickness of about one third the height of the wall, and of reinforced concrete in which strength replaces the dead weight of the other materials. Many walls are built with a

thickness of not more than one-fourth of the height and are perfectly safe when carefully constructed and properly drained. The water that accumulates behind a retaining wall is carried off through "weep" holes near the base.

In Europe some walls of comparative thinness are built sloping toward the material they retain. Walls, supporting the weight of buildings or other structures, need not be of as great thickness, as the superimposed weight adds to their stability.

C. E. F.

RETARD, in River Improvement. See DIKES.

RETICULUM (gen. *Reticuli*), the rhomboid, a small but rather bright looking constellation between Hydrus and Dorado. See STAR: map.

RETINA, DISEASES OF. See EYE, AFFECTIONS OF.

RETINOSPORA, a name still applied horticulturally to certain dwarf, or slow-growing conifers, chiefly introduced from Japan. These were once regarded as constituting a genus, but they are now identified as fixed juvenile forms of several species of cypress (*Chamaecyparis*) and arbor vitae (*Thuja*), and are now included in these genera. These dense, round-headed or pyramidal bushes, often bluish or greenish gray in foliage, are valued for formal gardens.

RETIREMENT. When any military officer has been 40 years in the service of the United States, he may be retired from active service by the President upon his own application. When any officer has been 30 years in the service he may, upon his own application in the discretion of the President be retired from active service, and placed upon the retired list with three-fourths of the highest pay of his grade. All officers shall be credited with the actual time they may have served as officers or enlisted men in the regular, or Volunteer Army or Navy or both, and shall receive all the benefits of such actual service in all respects in the same manner as if all said service had been continuous and in their regular service.

The application of an enlisted man for retirement shall be made to the President of the United States, and in computing the 30 years necessary to entitle him to be retired all service in the Navy or in the Army or Marine Corps during the Civil War from April 15, 1861 to August 20, 1866, and during the Spanish-American War from April 21, 1898 to April 11, 1899, shall be computed as double time.

RETROACTIVE LEGISLATION. The power of the Congress of the United States to enact retroactive legislation is definitely curtailed by Article I, Section 9 of the Constitution which provides that "no bill of attainder or ex post facto law shall be passed" and the further provision contained in the 5th Amendment that no person shall "be deprived of life, liberty or property without due process of law." The Ex Post Facto provision applies chiefly to certain criminal laws, the due process clause to laws impairing what might be called the right to freedom of contract.

BIBLIOGRAPHY.—W. B. Munro, *The Government of the United States*, 1919.

RETURN OF THE NATIVE, THE, a novel by THOMAS HARDY; published 1878. The scene is set in the author's imaginary Wessex County in southern England. The hero of this grim tragedy is Clement ("Clym") Yeobright, who returns from Paris to his native Egdon Heath fired with a great desire to do good among his own people. But in his marriage with the beautiful and passionate Eustacia Vye he loses much of his noble desire, sinking with her deeper and deeper into confusion and misunderstandings. At last Eustacia, utterly discontented with their life together, stealthily leaves Clym, and in despair drowns herself, carrying down with her Wildeve, a native of the Heath who has been in love with her and who attempts to save her. After this double catastrophe Clym becomes an itinerant preacher. Three important minor characters are Clym's mother, his cousin Thomasin (Wildeve's wife), and the old rattleman, Diggory Venn.

REU, in the genealogical, or as some hold the ethnological, tables of the BOOK OF GENESIS, is mentioned as the son of PELEG and father of SERUG, descending from SHEM, the son of NOAH, in the line of ABRAHAM, the great-grandson of Serug. Some scholars have tried to identify him with an Aramaean tribe called Ruua in southern Babylonia. Others have argued that he was a Mesopotamian deity. His son's name occurs as a place name in Assyrian inscriptions, and his own origin may have been the same.

REUBEN, the eldest son of the Hebrew patriarch, JACOB and his wife Leah. In the Bible story he is the son who tries to deliver JOSEPH and who offers his own sons as a pledge for the safety of his younger brother BENJAMIN. Like the other sons of Jacob or Israel, he becomes the progenitor of one of the 12 tribes. Its territory is said to have been east of the Dead Sea and the River Jordan, south of Gad and north of Moab, but it is not clearly distinguished from either of these. The tribe of Reuben early disappears and was probably dispersed among the other clans. The incident told in Genesis 35:22, is thought by some critics to have been told to show cause for punishing the tribe by dispersion, and may illustrate by personification some attack of the Reubenites on the Bilhah clan.

REUBENI, DAVID (c. 1490-c. 1535), Messianic enthusiast and pseudo-Messiah, was born at Khaibar, Central Asia, about 1490. In 1522 he went to Nubia, Egypt, where he made the claim that he was a descendant of Mohammed. After traveling in other parts of the Orient, he suddenly appeared in Venice about 1524, claiming to be a descendant of the old Hebrew tribe of Reuben and a brother of the reigning king of the tribe which, he asserted, still flourished as an independent state in the wilderness. He declared also that he had a mission to the pope from the Oriental Jews. He later enjoyed the protection of Pope Clement VII, also that of King John III of Portugal for a short time. In Portugal, at a time of intense Messianic expectations, he was widely acclaimed as the deliverer of the MARRANOS.

A year or two later, for unknown reasons, probably due to the denunciations of his enemies, Clement VII and John III withdrew their support and protection. SOLOMON MOLCHO, who had become Reuben's associate and had greatly strengthened his influence, fled with him to Regensburg, Germany. Here, despite the warning of Josel Rosheim, they persisted in their so-called Messianic work, with the result that Emperor Charles V soon had them seized and brought to Mantua. Later, after Molcho's execution in 1532, Reuben was taken to Spain and handed over to the Inquisition at Llerena. He appears to have been burned at the stake shortly after 1535; at any rate, nothing further is heard of him. Others are of the opinion that Reuben was poisoned; but this view is not generally given serious credence. The original of his diary is in the Bodleian Library at Oxford.

A. SH.

See Graetz, *History of the Jews*, 1926.

RÉUNION, also Bourbon, a French island of the Indian Ocean, one of the group known as Mascarene Islands, occupying an area of 970 sq. mi. The interior is mostly plateau dominated by lofty hills with volcanoes now nearly extinct. The highest summit is Piton des Neiges, 10,070 ft. above the sea. The chief products are sugar, rum, tapioca, vanilla, manioc and various essences. Principal towns are St. Denis, St. Pierre, St. Paul and St. Louis. Pointe-des-Galets, which is connected by rail with St. Pierre, is the chief port. Réunion was discovered by Mascarenhas, a Portuguese navigator, early in the 16th century. Pop. 1926, 186,637, 180,694 French.

REUTER, PAUL JULIUS, BARON VON (1821-99), founder of Reuter's Telegraph Bureau, was born July 21, 1821, in Cassel, Germany. After a short employment in a bank and then in a bookstore, he opened in Aix-la-Chapelle a bureau for the collecting and disseminating of telegraphic news. He attempted to transfer this office to Paris, but finding the French Government regulations impossible, Reuter moved to London. From there he spread his news bureau over the whole world. Governments granted him concessions for special cables and the Duke of Saxe-Coburg created him Baron. Queen Victoria allowed him the privileges of this rank in England. He died at Nice, February 25, 1899.

REUTLINGEN, a German city in Württemberg, on the Eschatz River, about 35 mi. south of Stuttgart. There are old fortifications and two city gates. Notable buildings in the town are the 13th century Church of St. Mary, the 14th century St. Nicholas's Church, and a technological and a research institute for the textile industry of which Reutlingen is a center. There are also leather and shoe factories, and manufacture of machines, tools, metal goods, furniture, corsets and wagons. Agricultural activity is in the cultivation of hops, grapes and fruit. Reutlingen was a free imperial city from 1213 until 1802. Pop. 1925, 30,501.

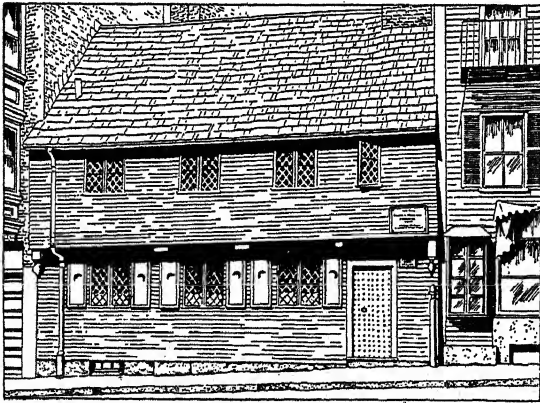
REVAL. See TALLINN.

REVELATION OF ST. JOHN THE DIVINE, the last book in the New Testament, also called the

Apocalypse of St. John, is thought to date from either 67 A.D. or 96 A.D. Those scholars who think that it is not a Johannine work point out that its Greek is greatly inferior to that of the fourth Gospel, that the spiritual conceptions of that Gospel are materialized in this work and that the author lacks an intimate idea of the personality of Jesus. The chief interest of the Revelation, however, centers about its interpretation and meaning. In all ages Christian scholars have been divided on the significance of such matters as the breaking of the seven seals, the sun-clad woman, the fiery dragon, the seven plagues, the great harlot, and the downfall of Babylon. Some have thought they applied to the destruction of Jerusalem in 70 A.D., others that they refer to the end of the world, or the second coming of Christ. Protestants have even interpreted the symbolism in the light of their conflicts with Catholics. It is certain that the key to the symbolism, if ever known, has been lost, and its readers are free to draw from it such inspiration and courage as they find in its curious pages.

REVERBERATORY FURNACE, a metallurgical furnace in which the fuel is burned in one compartment and the hot gases pass to another, or hearth which contains the material. Both compartments are covered by an arched roof which slopes downward toward the flue end to reflect heat to the hearth. See FURNACES, METALLURGICAL.

REVERE, PAUL (1735-1818), American engraver and patriot, was born at Boston on Jan. 1, 1735. He learned from his father the trade of a gold and silver smith and later became a copper engraver. In 1756



HOME OF PAUL REVERE IN NORTH SQUARE, BOSTON
Built about 1650; it is still standing

he took part in the expedition against Crown Point. He was one of the Boston grand jurors refusing jury service in 1774, and took part in the Boston Tea Party. In Dec. 1774, on a mission to Portsmouth, N.H., he influenced the colonists to the seizure of Fort William and Mary, which was one of the first uses of military force in the Revolutionary War. On the night of Apr. 18-19, 1775, Revere rode from Charlestown to Lexington to give warning of the approach of British troops. In Apr., 1776, he became major of infantry in the Massachusetts militia, and in

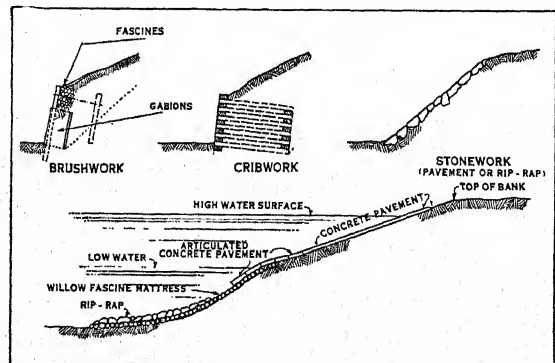
November was promoted to lieutenant-colonel of artillery, receiving command of Fort Castle William. Revere subsequently resumed his work as a manufacturer of gold and silver ware. He died in Boston on May 10, 1818.

REVERE, a residential city and pleasure resort, in Suffolk Co., Massachusetts, situated on Massachusetts Bay, 4 mi. northeast of Boston. Transportation facilities include the Boston and Maine Railroad, bus lines, two electric railways and an airport. Revere Beach, a half-moon of white sand extending from Winthrop Promontory northward to the Point of Pines, has been called the Coney Island of Boston. In 1929 the local retail business reached a total of \$6,792,530. The first settlement here was made in 1626, under the name Rumney Marsh; this was part of Boston until 1739, when it became merged with Chelsea Township. In 1846, a part of Chelsea Township was divided off and called North Chelsea. Winthrop was separated from North Chelsea in 1852, and North Chelsea was renamed Revere in 1871, in honor of Paul Revere. In 1915 Revere was incorporated as a city. Pop. 1920, 28,823; 1930, 35,680.

REVEREND, the usual title of respect applicable to all clergymen when mentioned or addressed in writing. The abbreviation is "Rev." followed by the given name or initials, as "Rev. John Smith," never "Rev. Smith." When writing to a priest of a religious order, it is correct to address him as "Father Blank" or "Rev. Father James Blank." Still more courteous is "The Reverend." The title is also given to mothers-superior. Among the higher clergy "Very Reverend" is used for a dean, "Right Reverend" for monsignor in the Catholic Church, "Most Reverend" for a bishop and for an archbishop of the Catholic Church.

REVERSING LAYER, that part of the sun's atmosphere directly above the photosphere. See SUN.

REVTMENTS, works placed directly on a shore, bank or slope to stabilize a slope or prevent erosion. Many forms are used, depending upon purpose, conditions, materials available, etc., including "rip-rap" or



TYPICAL REVTMENTS FOR MISSISSIPPI RIVER BANK PROTECTION

rock placed at random; brush work in the form of "mattresses," "fascines," "gabions"; pavements of stone or concrete; and cribs. Trees, shrubbery, vines, and sod are also used for the protection of banks and

slopes. Willows are often used for stream bank protection under favorable circumstances, because of their ease of planting, quick growth, and interlacing roots. See PROTECTION SHORE; RIVER IMPROVEMENT.

REVIEW, a PERIODICAL which specializes in the publication of critical essays and articles. The earliest example was Daniel Defoe's *A Review of the Affairs of France and of all Europe, as influenced by that Nation* which appeared in 1704. This type of publication is extremely influential in both England and France, but in America magazines have been more popular. A review is never illustrated and, although short stories and serialized novels are acceptable, they do not constitute its main appeal, which lies in the expert treatment of historical, literary, sociological, and political subjects. The two most famous English reviews are *The Edinburgh Review* which, begun in 1802, ceased publication in 1929, and *The Quarterly*, which still exists, having been founded seven years later than *The Edinburgh Review*. Well-known modern English Reviews are *The Nineteenth Century and After*, *The Contemporary*, *The National*, *The English*, *The Fortnightly*. The most famous French review is the *Revue des Deux Mondes*. *The Yale Review*, appearing quarterly, and *The Sewanee Review* are American examples of this type of publication.

REVOLUTION, a term commonly used to denote a rapid and basic change in political or economic control, particularly an illegal and violent seizure of power. Properly, it denotes the transfer of property and political power from one owning class to another, whether or not accompanied by illegality and violence. Revolution is commonly contrasted with evolution and reform to indicate a violent as against a slower, peaceful process. But revolution is historically only a speeding-up of an evolutionary process, a final break-up of a decaying system under the impact of a rising class. Revolution is often confused with revolt—a limited, violent and unsuccessful attack on a government or economic rulers.

The two significant revolutions of modern times were the French, which marked the break-up of feudalism and the rise of the capitalist business class; and the Russian, both antifeudal and anticapitalist. Colonial revolutions, such as the American, South American, Mexican and others, unlike the French and Russian, have not marked the rise to power of a new economic class, but the substitution of a native feudal or capitalist class for a foreign.

Violence, so characteristic of most revolutions, depends on the ability of the entrenched class to command the loyalty of armed forces. The French Revolution—i.e., the change in class control of property—was achieved without bloodshed, but the counter-revolution of the feudal class brought bloody strife. In revolutions which do not occur in defeated countries following war, resort to arms is the common tactic. All colonial revolutions save the Indian have been essentially violent. In India for the first time in history the dominant forces in revolt mobilized

weapons of non-violence: the boycott and peaceful disobedience of imposed laws.

The transfer of economic and political power by revolution does not commonly achieve quickly a change in the methods of government. The form tends to remain, controlled by new hands. The French Revolution, followed by a military dictatorship, took a half century to develop political democracy, even though the transfer of land to the peasants and of commerce to the capitalist class was complete.

The two tendencies to revolution dominant in the world are those of the working classes and peasants against capitalism, and of the Asiatic and African peoples against alien imperialism. R. N. BA.

BIBLIOGRAPHY—P. Kropotkin, *The Great French Revolution*, N. Lenin, *State and Revolution*.

REVOLUTIONARY TRIBUNAL, THE. When the REIGN OF TERROR was set up in France Danton originated the idea of the Revolutionary Tribunal as the chief instrument of the Committee of Public Safety, whose business it was to maintain order throughout the country. This extraordinary court of justice was established in Mar. 1793, but was reorganized in the following autumn with sixteen judges, sixty jurors and a public accuser, an office made infamous by the bloodthirsty Antoine Fouquier-Tinville. With the assistance of local tribunals, not only Paris, but all France was terrified into temporary submission. Those suspected of disloyalty to the Revolution were accused, examined and executed in rapidly increasing numbers until in June and July, 1794 no less than 1,376 were guillotined. The terrible Law of Suspects had given Robespierre the control in the Tribunal, but during the reelections that followed his death, safe-guards were provided for the defense of the accused. After a few months of more merciful activity the Tribunal was suppressed May 31, 1795. Its final act had been the trial and sentence to death of Fouquier-Tinville and fifteen of the most brutal of the judges and jurors who had served the Tribunal during the worst days of the Terror.

REVOLUTIONARY WAR, 1775-81, known also as the American War of Independence, the conflict between Great Britain and the THIRTEEN COLONIES in America, in which the colonies, through the CONTINENTAL CONGRESS, asserted themselves as independent states, and achieved international recognition of that independence. The sequence of events and the growing divergence of attitude between the English governing class and the people of the colonies which caused the war are sketched under UNITED STATES, HISTORY OF, in their chronological place. The first armed conflicts occurred in Massachusetts, which province had protested against the new economic policy under George III from the first news of its inception, and in which the "natural rights of man" had been invoked to nullify Acts of Parliament even earlier. (See WRIT OF ASSISTANCE.) But the immediate response of the other colonies through the Con-

tinental Congress and the provincial legislatures revealed that the incentives to revolution were not local but continental. "The justification of the American Revolution," writes Prof. R. G. Usher, "lies in the fact that the colonies were strong enough to stand alone, had governed themselves for a century and more, and could see no economic, ethical, or constitutional advantages in such a connection as the English proposed."

The British Occupation of Boston. When Gen. Thomas Gage, royal governor of Massachusetts, countermanded the scheduled convening of the Massachusetts legislature, the Association, last and most extensive of the NON-IMPORTATION AGREEMENTS, was being enforced by local committees not averse to physical coercion; terrorism of LOYALISTS was under way; military companies were learning the manual of arms in village squares; and state affairs in Massachusetts bordered on anarchy. Many of the assemblymen, none the less, met at Salem on the appointed date, Oct. 5, 1774, and resolved themselves into a Provincial Congress with John Hancock as president. This Congress, removed to Cambridge, proceeded to form a military organization, appointed committees to put the province in a state of defense, and directed the organization of MINUTE MEN for immediate service. The royal courts were suspended; Gage fell back upon his authority as commander of the King's troops in North America, sent expeditions to seize military stores in various parts of the province, and retired within fortifications at Boston. Last minute efforts of Burke, Fox, Pitt and other liberals in Parliament were unavailing. Lord North secured from both Houses addresses to the King declaring that rebellion existed in Massachusetts, and pledging their aid in subduing it, Feb. 9, 1775; and statutory restraint was put upon the trade of all colonies subscribing to the Association. Gage's program of removing military stores from local magazines to Boston encountered armed resistance at Lexington and Concord (*see* LEXINGTON, BATTLE OF; CONCORD, BATTLE OF); and within a few days some 16,000 New England militia-men had gathered about Boston, the nucleus of the American army of the Revolution. Debates, petitions and protests were suspended by the appeal to arms. The Continental Congress on June 14 decided to organize a continental army, and on the following day George Washington, at the suggestion of John Adams, who grasped the wisdom of identifying the South with New England's fortunes, was unanimously appointed to "command all the continental forces, raised or to be raised, for the defense of American liberty."

On July 3, 1775, on Cambridge Common, Washington took formal command. Already, while Artemas Ward was chief in command, the troops had fought the BATTLE OF BUNKER HILL. Washington continued the siege of Boston, pushing his lines forward in the hope of drawing the enemy into an active engagement. Although Washington's situation became "inexpressibly distressing" in the absence of money, lack of food and equipment, trials of organ-

ization, and the pervasive "dirty, mercenary spirit" (Washington's phrase), the British commander within Boston faced no pleasant outlook. Gen. William Howe had superseded Gage in command; with Howe had come Generals Clinton and Burgoyne and 10,000 troops. Howe's instructions were not to engage in military conquest except as a last resort, but to observe the disintegration of the rebellion as the malcontents became aware of their weaknesses, jealousies of the states asserted themselves, and the loyalty of the large majority of the colonial population to England became audible. Boston, with distress among the inhabitants as food and fuel were exhausted, became an untenable vantage point when on the night of Mar. 4, 1776, the commanding eminence of Dorchester Heights was fortified by Continental artillery and Howe with his army and many refugee Loyalists embarked for Nova Scotia. Meanwhile an attempt to bring Canada, the "fourteenth colony," into the Revolution, had been tried and failed; success at Ticonderoga (*see* TICONDEROGA, BATTLE OF) was followed by defeat at Montreal and Quebec (*see* MONTREAL, BATTLE OF; QUEBEC, BATTLE OF), and in 1776 Col. Benedict Arnold withdrew the remnant of his patriot army from Canada. A diversion of British force into the South met no success and was abandoned after the naval attack upon Ft. Moultrie (*see* FORT MOULTRIE, BATTLE OF), June 28, 1776.

The Middle States Campaign. The British ministry, belatedly committed to a policy of active suppression of the Revolution, found difficulty in raising troops in Britain, and turned to the petty German princes. Nearly 30,000 mercenaries were furnished in the course of the war, 12,000 from the landgrave of Hesse-Cassel. The plan of the ministry in 1776-77 was to strike hard at the center of the insurrectionary area. New York, rather than Boston, was to be the base of military operations, and cooperating forces from Canada should sweep down the Lake Champlain-Lake George highway and the Mohawk valley, thence down the Hudson valley to New York to complete the cleavage. The policy of the Continental army was necessarily defensive.

Howe, heavily reinforced, sailed from Halifax in June 1776, and by the pressure of numbers (*see* LONG ISLAND, BATTLE OF) forced Washington to recall his troops from Brooklyn Heights to concentrate in Manhattan Island. Howe's leisurely effort to check the retreat of the Continental army to the forts on the Hudson was marked by two engagements (*see* HARLEM HEIGHTS, BATTLE OF; WHITE PLAINS, BATTLE OF), which served less to change Washington's plans than did the discovery of the inability of the forts to prevent ships from passing up the river. Ft. Washington (*see* FORT WASHINGTON, BATTLE OF) was captured by the British when Washington's orders to evacuate were disregarded; its companion on the opposite bank, Ft. Mifflin, fell to the British on Nov. 19, 1776 because of the wilful inefficiency of Gen. Charles Lee. The Continental army began its famous retreat across New Jersey toward Philadelphia, pursued by British troops

under Gen. Cornwallis. Howe dispatched a force to Newport as a base of future operations against New England, and, convinced that he had ample time to capture Philadelphia before his troops should be needed in the Hudson valley, marched across New Jersey. Harassed by loyalism in New Jersey, defections from his army as enlistments expired, the ineptitude of the commissariat and the rigors of winter, Washington relied on his wits, and at Trenton and Princeton (*see* TRENTON, BATTLE OF; PRINCETON, BATTLE OF) achieved amazing successes. Cornwallis retreated to New Brunswick, and Howe returned to New York. Washington, in winter quarters at Morristown, gained time for recruiting and reorganization. Against the tendency of the states to upbuild their militias and disregard the needs of the Continental army, Washington's army was raised from about 1,500 men in January to 4,000 men in Mar. 1777. At that point for the next several months desertions approximately counterbalanced enlistments. Washington did gain from the Continental Congress the personal authority which alone could mitigate the bickerings and recalcitrance of many junior officers.

Early in June 1777 Gen. John Burgoyne, with a superb force of 4,000 British regulars, 3,000 mercenaries and 650 Canadian militia and Indians, marched from Canada to gain control of the upper Hudson, to occupy Albany and there join forces with Howe for a concentrated drive against New England. Gen. Howe, in New York, on June 5 received from the British ministry a copy of the plan of the northern campaign, but through the egregious negligence of Lord George Germain the essential order which would have directed Howe to proceed to join Burgoyne was omitted. By July 1 Burgoyne's troops appeared before Ft. Ticonderoga; the patriot garrison of 3,000 men under Gen. St. Clair withdrew and joined the main northern army under Gen. Schuyler at Ft. Edward. This post was in turn abandoned as Burgoyne approached; but the destruction of bridges and the obstruction of the forest roads by Schuyler's men, and particularly inadequate transportation and commissary facilities, held Burgoyne's advance to a creeping pace. A detachment of Germans sent to Bennington (*see* BENNINGTON, BATTLE OF) was defeated by local volunteers, Aug. 16. The British army under Col. St. Leger, marching from Oswego across New York State, had been checked earlier in the month at Oriskany (*see* ORISKANY, BATTLE OF) by the embattled settlers of the German Flatts. When a relief expedition of 1,200 men under Gen. Benedict Arnold marched up the Mohawk valley St. Leger's Indian allies took flight and St. Leger abandoned the proposed juncture with Burgoyne. (*See* FORT STANWIX, BATTLE OF.) Burgoyne's army was isolated; and despite the fact that Congress supplanted Schuyler with the scheming but incompetent Gen. Gates (*see* CONWAY CABAL), at Stillwater and Saratoga (*see* STILLWATER, BATTLE OF; SARATOGA, BATTLE OF) the humiliation of Burgoyne, whose greatest error was his having adhered too closely to instructions from Lon-

don, was completed. Meanwhile Howe, after delaying in futile maneuvers to draw Washington, in northern New Jersey, into a decisive engagement, embarked his army to the head of the Chesapeake in a return to his own favorite campaign. At Brandywine (*see* BRANDYWINE, BATTLE OF) Washington delayed Howe's march on Philadelphia; and after the British were in possession of the capital he made at Germantown (*see* GERMANTOWN, BATTLE OF) a desperate but frustrated effort to defeat the main body of British troops.

The French; the Frontier; the Sea. To the long-standing diplomatic opposition of France and England was added the enthusiastic sympathy of the French people for the republican philosophy of the Revolution to produce a military alliance of France with England at the expedient moment; the victory of Saratoga provided the moment. With the Comte de Vergennes, minister of foreign affairs, and Benjamin Franklin as principal negotiators, on Feb. 6, 1778 two conventions were signed: one a commercial treaty; the other a military and political alliance recognizing the independence of the United States and declaring the object of the concord to be the achievement of that independence. Henceforth the French fleet, especially in diverting British ships which otherwise could have been used to transport additional troops to America, was of great service to the Revolutionary cause; but France had tacitly and informally assisted the Americans since the outbreak of revolution. Vergennes and CARON DE BEAUMARCHAIS secured and forwarded money and supplies; in May 1776 the French treasury loaned the Continental Congress 1,000,000 livres; Silas Deane, commissioner of the Congress in France, was "hourly fatigued" by French adventurers applying for commissions in the Revolutionary army.

The alliance of 1778 provided that France was to have the right to capture and retain any British islands in or near the Gulf of Mexico. The effect of this clause was that the French fleet of 18 vessels under Count D'Estaing, which arrived off the American coast on July 7, 1778, made only desultory gestures toward the capture of the British fleets in New York and Newport, then sailed for the West Indies to attempt the capture of Grenada, Santa Lucia and St. Vincent.

Along the frontier the Indian menace assumed ominous proportions in 1778. The TRANSYLVANIA settlements were saved by their strong palisades; but in western New York and Pennsylvania the Indians, with Canadian allies, committed the most ruthless horrors of the Revolution. In May 1778 George Rogers Clark (*see* CLARK'S EXPEDITION) began his epochal conquest of the Old Northwest. *See also* WYOMING MASSACRE.

After the defeat at Germantown, Washington withdrew to VALLEY FORGE, headquarters during the disheartening winter of 1778-79. Gen. Howe was recalled after an amiable winter in Philadelphia and supplanted by Clinton, whose instructions were to

evacuate the city, of little military importance, and transfer his army to New York. On June 18, 1779, the British army marched out; Washington made a well-planned attempt to defeat the army on the march, at Monmouth (*see MONMOUTH, BATTLE OF*), but was frustrated by the treachery or ineptitude of an aide. For the next three years Clinton remained in New York while Washington kept vigil at White Plains or other nearby points. Two brilliant exploits of American detachments, the capture of Stony Point (*see STONY POINT*) by Gen. Wayne and the assault upon Paulus Hook, a fort on the site of Jersey City, served to persuade Clinton to remain inactive.

Incomplete reports indicate that over 2,000 American merchant vessels were equipped with guns and engaged in privateering. Several of the states organized navies which also preyed upon British commerce. Franklin wrote from France, Feb. 1777, "That which makes the greatest impression in our favor here is the prodigious success of our armed ships and privateers," and estimated that the interruptions of the West Indies trade had cost the merchants of London £1,800,000. The British naval forces, which might well have all but destroyed American commerce and fisheries, were not consistently used for that purpose. Congress on several occasions voted funds for the creation of small fleets used to assist land forces in specific campaigns or to secure munitions. Capt. John Paul Jones of the Continental Navy in 1778 and 1779 conducted daring raids upon British ships in European waters. (*See BON HOMME RICHARD AND SERAPIS.*) Other Americans who won brilliant naval engagements were Lambert Wilkes, Gustavus Conyngham and Capt. John Barry.

The Continental Congress, without constitutional authority, feared to attempt measures of taxation, and relied heavily on the emission of bills of credit. In the course of the war \$241,500,000 in treasury notes was issued; and despite the protests of Congress, the various states issued \$200,000,000 in paper currency. A dollar in Continental currency was by Jan. 1779 worth but twelve cents in specie, and the depreciation continued until the value almost reached the vanishing point. State laws, without uniformity, attempted to regulate prices and to stabilize the state currency at its par value, of course without effect. Requisitions of specie by Congress upon the states were subject to the sovereign whim of the state, and after the first requisition were of little effect. Some specie was acquired by borrowing; almost \$8,000,000 was borrowed in Europe, which sum had greater purchasing power than the \$63,000,000 in paper currency loaned by Americans. Lotteries, confiscation of Loyalists' estates, the sale of prize ships, and a variety of expedients contributed to the war funds of the states. But there were never adequate finances in the states, and less for the skeleton of a general government.

The Southern Campaigns. Turning to the South, where numerous Loyalists were expected to take up arms when the presence of British troops should lend encouragement, the British launched a new campaign

late in 1778. Col. Archibald Campbell with an expeditionary force from New York took Savannah (*see SAVANNAH, BATTLE OF*); and before spring the British Gen. Prevost was in control of Georgia. After routing the American troops at Briar Creek, Prevost crossed the Savannah River into South Carolina, and, with Indian allies, devastated the region. At Charleston Gen. Benjamin Lincoln's patriot troops halted Prevost and forced a retreat to Savannah. Within that city the British withstood the combined attack of French and American land and naval forces, Sept.-Oct. 1779; the anticipated support of Loyalists appeared, and Charleston (*see CHARLESTON, BATTLE OF*) surrendered when Sir Henry Clinton, Gen. Cornwallis, and a British fleet invested the city by land and sea. Cornwallis with 5,000 men was left to continue the subjugation of the South. The injudicious spoliation of South Carolina by British troops alienated much Loyalist sympathy at a time when independent bands of frontiersmen engaged in a series of harassing, provoking raids. These bands, under Francis Marion, Andrew Pickens, Thomas Sumter and other popular leaders, were successful in harrying the British outposts while the regular American troops in the South remained lamentably weak. Gen. Gates, appointed to chief command in the South, arrived in July 1780. In an unexpected battle at Camden (*see CAMDEN, BATTLE OF*) the Continental army was routed and Gates himself fled some 200 miles within four days. Cornwallis was proving himself the most formidable opponent whom the patriot leaders had to face; but at King's Mountain (*see KING'S MOUNTAIN, BATTLE OF*) his Tory allies were forced to surrender, and at Cowpens (*see COWPENS, BATTLE OF*) the army under his aide, Col. Banastre Tarleton, was shattered, Jan. 17, 1781. Despite these losses, Cornwallis marched through North Carolina, driving the Continental army, now under Gen. Nathaniel Greene, before him. At Guilford Court House (*see GUILFORD COURT HOUSE, BATTLE OF*) the two armies met, but Greene retreated with his force intact. Cornwallis retired to Wilmington, N.C., to refit his command for the campaign which he had himself conceived, to subjugate Virginia. Greene, however, pushed into the lower South to undo the British occupation, and in September, after much hard fighting with varying success (*see EUTAW SPRINGS, BATTLE OF*) achieved his main object, hemming the British army under Lord Francis Rawdon in Charleston.

Cornwallis, meanwhile, left Wilmington on Apr. 25, 1781, and receiving reinforcements under Generals Benedict Arnold and William Phillips at Petersburg took control of the heart of Virginia; the small American force in the state, under Gen. Lafayette, was twice repulsed. Late in July Lafayette established his army at Malvern Hill; Cornwallis retired to Yorktown. Gen. Washington, projecting an attack upon Clinton in New York, received word from Comte de Grasse proposing joint operations in Virginia. Changing his plans, Washington called Rochambeau's French army from Newport, where it had arrived in July 1780 and

REYNOLDS



"THE AGE OF INNOCENCE"

By Sir Joshua Reynolds (1723-92). In the National Gallery, London.

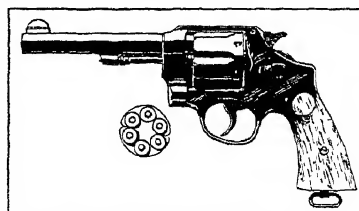
had remained idle since, and the allied force of 6,000 men hurried overland to the head of Chesapeake Bay, and on Sept 18 were in the neighborhood of Yorktown. Meanwhile the French fleet had arrived, and reinforcements from this and other sources brought the American strength to 16,000 men. Deserted by the British fleet, Cornwallis was exposed to a campaign of attrition; and late in October, while the band played *The World's Turned Upside Down*, the British army marched out to become prisoners of war. (See also YORKTOWN.)

The fatal error of the British lay in the dilatory course of Gen. Howe in 1776, when with an overwhelmingly superior force he forebore to subjugate New York and New England in the expectation that the Revolution would collapse without forcible suppression. Washington's personal leadership was in 1777 probably the greatest sustaining pillar of the Revolution until the significant news of Burgoyne's surrender. Then, when in 1778 the British took up the war in earnest and the struggle acquired a new, virulent character, French assistance appeared. Under Greene the quartermaster's department had at last begun to function, and the Continental troops had been drilled by Baron von Steuben. And while the financial structure of the Revolution was anything but adequate, Haym Salomon, Robert Morris and others had contributed their financial means and talents to relieve the stringency. The physiography of the revolutionary area baffled the British; a seat of war 1,000 miles in length, intersected by large rivers, which could have been subdued and policed only by an army of 50,000 men or more, involved an unthinkable expense. By Aug. 1779 Great Britain was at war with the three next greatest naval powers in the world, France, Holland, Spain; so much of her military power was restrained or diverted by these continental enemies that operations against the American rebels were restricted. Only the refusal of George III to reconcile himself to American independence prolonged the war technically after Yorktown. Party battles in the House of Commons and the violent assertion of Ireland's home-rule aspirations distracted the last months of Lord North's ministry, and late in Mar. 1782, the Whig party was in power. Peace negotiations followed in which the American commissioners practically dictated the terms. See PARIS, TREATY OF, 1783. E. D. B.

BIBLIOGRAPHY.—S. E. Morison, *Sources and Documents Illustrating the American Revolution*, 1923, is a convenient handbook. C. H. Van Tyne, *The American Revolution*, 1905, an excellent short narrative, lists larger collections of source material and other bibliographical aids. Reliable histories are G. O. Trevelyan, *The American Revolution*, 6 vols., various dates; S. G. Fisher, *The Struggle for Independence*, 2 vols., 1908; C. H. Van Tyne, *The War of Independence: American Phase*, 1929; W. E. H. Lecky, *The American Revolution*, 1898. Military campaigns are the subject matter of H. B. Carrington, *Battles of the American Revolution*, 2 vols., 1876. See also T. Frothingham, *George Washington, Commander in Chief*, 1930; L. C. Hatch, *The Administration of the American Revolutionary Army*, 1904 and E. S. Maclay, *History of the United States Navy*, 3 vols., 1898-1901. Special studies of great interest are L. B. Namier, *England in the Age of the American*

Revolution, 1930; A. M. Schlesinger, *Colonial Merchants and the American Revolution*, 1918, and E. S. Corwin, *French Policy and the American Alliance of 1778*, 1916.

REVOLVER, a short-barreled, hand-firing weapon, carrying about six cartridges in a revolving cylinder. By a single pull of the trigger, the cylinder is rotated



SMITH AND WESSON ARMY REVOLVER

and the firing mechanism is cocked and fired. Two types, each .45 caliber, known as the Colt and the Smith & Wesson, were used in the World War.

REYES, RAFAEL (1850-1921), Colombian soldier and statesman. He served as representative and held numerous cabinet positions. After crushing a revolution in 1895, he represented Colombia as ambassador both in Europe and America. In 1904 he became president of Colombia, and succeeded in establishing peace in the country after 50 years of civil war. He encouraged primary education and reestablished the University of Bogota, called a convention to frame a new constitution, reorganized the system of finance, and established the Bank of Colombia. In spite of his progressive reforms he was a dictator, and public sentiment against him became so strong that he was forced to resign in June 1909.

REYMONT, LADISLAW STANISLAS (1867-1925), Polish author, was born at Kobieli Wielkie, Poland, May 7, 1867. While holding a small railroad position he began to write, and between 1904-09 published *The Peasants*, a novel in four volumes, each named after a season. This work describes minutely the lives, instincts and aspirations of the Polish peasantry and is considered a genuine rustic epic. In 1924 Reymont was awarded the Nobel Prize for *The Peasants*. He died Dec. 5, 1925.

REYNARD THE FOX appears as a character in popular tales in Flanders in the 12th century. He generally represents the triumph of the cleverness of the weak over the force of the strong and so lends himself admirably to satire against the rich, the feudal system and the higher clergy. The tales appear to have grown to wide popularity both in French and German, even to some extent in Latin, by the 13th century. As to the source of the material it is possibly indicative that the personal names in the Reynard epics are in general Germanic. Although CHAUCER made some use of Reynard material the figure became widespread in English only with the Reformation.

REYNOLDS, GEORGE MCCLELLAND (1865-), American banker, was born at Panora, Ia., Jan. 15, 1865. In 1879 began his career in the farm-loan business, becoming president of the Des Moines (Ia.) National Bank in 1895. Because of

his intimate knowledge of farm financing, he was summoned in 1897 to the Continental National Bank of Chicago, and appointed cashier. He became chairman of the board in 1920, holding the same post in the Commercial Trust and Savings Bank. The two institutions were consolidated, 1927, as the Continental Bank and Trust Co., and in 1929 absorbed the Illinois Merchants' Trust Co., Chicago, in which merger Reynolds remained at the head of the executive committee. He was made director of the Federal Reserve Bank of Chicago, and is connected with many financial and manufacturing concerns in a like capacity.

REYNOLDS, JOHN FULTON (1820-63), American soldier, was born at Lancaster, Pa., on Sept. 20, 1820, graduated in 1841 at West Point, and was assigned to the artillery division of the army. In the Mexican War he took part in the defense of Ft. Brown and the battles of Buena Vista and Monterey. During the Civil War he made a brilliant record as an artillery commander in the Peninsular and Northern Virginia campaigns and was commissioned a colonel in the United States Army. He led the main attack on the Confederate left at Fredericksburg, and was chief in command the first day at Gettysburg, where he was killed on July 1, 1863.

REYNOLDS, SIR JOSHUA (1723-92), English portrait painter, was born at Plympton, Devonshire, July 16, 1723. He studied under Hudson in London, spent two years in Italy and about 1752 established himself in London, where his success was immediate. Becoming the first president of the newly-formed Royal Academy, he delivered the famous *Discourses*, lectures on art. Reynolds was happy in his posing of single figures but was less fortunate in group arrangements and in his attempts to depict arrested motion. He was unable to draw the human figure correctly and the exquisite golden tonality of his canvases is often blackened by his reckless experiments with pigments. His greatest works are such male portraits as that of Lord Heathfield, in the National Gallery, London, and those of Burke, Garrick, Dr. Johnson and Fox. His most subtle female portrait is perhaps that of Nelly O'Brien, in the Wallace Collection, London. The celebrated *Mrs. Siddons as the Tragic Muse* is now in the Henry Huntington Art Gallery, San Marino, Cal. Among Reynold's many charming interpretations of children are *The Age of Innocence*, *The Strawberry Girl*, *Master Hare*, *Lady Caroline Montagu*, *Simplicity* and *Miss Bowles*. Reynolds died in London, Feb. 23, 1792.

REYNOLDS' NUMBER, in hydraulics, a number equal to the product of the critical velocity of a fluid (see *FLOW IN PIPES*), the diameter of the pipe and the DENSITY of the fluid divided by the VISCOSITY of the fluid. Professor Reynolds found this number to be approximately 2,000.

RHAETIAN ALPS. See *ALPS*.

RHAMNUS, in botany, the large genus of woody plants, commonly called BUCKTHORN, from which the buckthorn family (*Rhamnaceæ*) takes its name.

RHAPSODY, originally, among the early Greeks, an epic poem or a part of one, particularly a book of the *ILIAD* or the *ODYSSEY*, which could be recited conveniently at one time. The so-called Rhapsodists, wandering minstrels who both recited and commented on the Homeric poems, gradually lost their popularity after the poems could be circulated in manuscript copies. In the modern sense, a rhapsody may be any piece of writing in verse or prose which expresses exaggerated or over-exalted sentiments.

RHAZES (850-932 A.D.), Arabian physician, was a great clinician, ranking with Hippocrates, Aretaeus and Sydenham. His description of smallpox and measles is the first authentic account in literature. Rhazes was the author of approximately two hundred medical contributions, most of which unfortunately have been lost.

RHEA, in Greek mythology, the goddess of productivity, the same as Ops or CYBELE. Her attendants were the Curetes.

RHEA (*Rhea americana*), a South American bird related to the ostrich. Rheas are smaller than the African ostrich, having three toes instead of two, but otherwise are closely similar in structure, manner of life and reproduction. They are three species inhabiting the plains from Brazil to Patagonia, and they have acquired great speed and remarkable cunning in escaping enemies. In general color rheas are dark gray. Their plumes, which lack softness and curl, are little valued in personal decoration. They are, however, extensively employed in making various useful articles, as feather-dusters, hence rhea skins are an important part of the exports from Buenos Ayres. In consequence the birds themselves have become nearly exterminated in most places.

E. I.

RHEES, BENJAMIN RUSH (1860-), American educator, was born in Chicago, Feb. 8, 1860. He graduated in 1883 at Amherst and in 1888 at Hartford Theological Seminary, and entered the Baptist ministry. After three years as pastor at Portsmouth, N.H., Rhees became professor of New Testament interpretation at the Newton Theological Institute, Newton, Mass., and continued there until 1900 when he was made president of the University of Rochester. His writings include *The Life of Jesus of Nazareth*, 1900, and *St. Paul's Experience as a Factor in His Theology*, 1896.

RHEIMS. See *REIMS*.

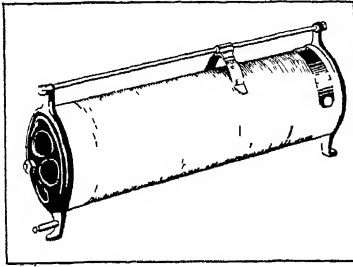
RHEINGOLD, DAS, an opera by RICHARD WAGNER, one of a cycle of four music-dramas; see *NIBELUNGEN, RING OF THE*.

RHENIUM, a metallic chemical element belonging to the same group as manganese and masurium, symbol Re, atomic weight 186.31. Its existence as an element was first proved spectroscopically in 1925 by Noddack and Tacke. This was substantiated in 1930 at the Bureau of Standards.

RHEOSTATS, an electrical RESISTANCE device constructed so as to permit easy adjustment of the value of the resistance between its terminals.

The slide-wire rheostat comprises a coil of resist-

ance wire mounted on a suitable insulating support with an adjustable slider which can make contact with successive turns of the coil. Binding posts are provided so as to make contact with either end of the



SLIDE-WIRE RHEOSTAT

coil and the slider. In the smaller sizes, the wire is wound on a strip of Bakelite or fiber; larger sizes are usually wound on metal cylinders coated with baked vitreous enamel.

For some types of laboratory work, carbon-block rheostats are used. These consist of a number of flat carbon plates stacked on a framework on which a compression screw is mounted. By tightening the screw, the plates are forced into contact and a smooth variation of resistance is obtained. The same principle is applied in a number of small resistance devices, adapted particularly for radio purposes and using either small plates or granulated carbon.

Rheostats for field-circuit control on electrical machinery (see DYNAMO ELECTRIC MACHINE) are commonly made with the resistor element tapped at intervals and provided with a dial switch for making contact. General purpose rheostats for controlling relatively large currents are often made with an individual knife switch at each tap instead of a dial switch.

The water rheostat, or "water barrel," is a type which is very useful as a means of loading electrical machinery or circuits under test. In its simplest form, it consists of a pair of heavy metallic plates suspended in a barrel of salt water with a suitable mechanism for varying the spacing of the plates. The resistance is adjusted by changing the spacing, or, if a large change is necessary, the concentration of the solution is changed either by adding fresh water or more salt.

In RADIO RECEIVERS, rheostats are used to regulate the current in filament circuit of the tubes (see TUBES, ELECTRONIC).

W. H. T.

RHETORIC, the art of using language so as to convince, persuade, or influence others; or the body of rules derived from or governing such employment of it.

The term rhetoric has been variously interpreted ever since the Sophists began to discuss the subject in the 5th century B.C. ARISTOTLE, whose *Rhetoric* is one of the outstanding classics, considers it part of oral persuasion, and formulates his rules accordingly. With the rise of written literature, however, rhetoric came to be applied to writing rather than to speaking, and was used in a broader significance. Thanks

largely to the work of the rhetoricians of the 19th century, it is now generally defined as the art of prose composition, as opposed to "poetics," or imaginative composition.

The term has, however, fallen somewhat into disuse, complaint being made that the classic rhetoric of the 19th century had taught the writer to name and define his tools, but not to use them, and emphasized theory and definition at the expense of practice. By degrees the term "composition" which was freely used along with "rhetoric," seems to be displacing it.

The four major fields of rhetoric or composition are exposition, which seeks to explain something; argumentation, which endeavors to convince a person that some proposition is true or not true, and that, therefore, something should or should not be done; narration, which recounts happenings or tells a story; and description, which seeks to make one realize how a thing looked, sounded, felt, tasted, or smelled. The newer rhetoricians recognize considerable overlapping in these four fields, and perceive that a closer relationship exists between description and narration, or between exposition and argument, on the one hand, than between narration and argument, or description and exposition, on the other. Baldwin's division of composition into the composition of ideas and the composition of images is convenient, since any composition seeks either to "convey information, impart ideas, or urge action, on the one hand" (the composition of ideas), or, on the other, to "suggest images, stimulate perception, or widen or intensify experience" (the composition of images). The fourfold classification, however, is not without advantages, and the devices by which effectiveness is obtained remain the same under either system of classification, and are the subject matter of composition as they are of rhetoric.

K. D. S.

BIBLIOGRAPHY.—Aristotle, *Rhetoric*; Quintilian, *Institutio*; A. Bain, *English Composition and Rhetoric*, 1872; R. Whately, *Elements of Rhetoric*, 1880; A. S. Hill, *The Principles of Rhetoric*, 1895; C. S. Baldwin, *College Composition*, 1928.

RHEUMATIC FEVER, also called inflammatory rheumatism, an acute disease, affecting mostly young people, accompanied by fever, exquisite pain in one or more joints and frequently an affection of the heart which results in more or less permanent damage. The disease is more common in temperate or cold climates than in the tropics. The precise cause is as yet undetermined, but there is little reason to doubt that it is bacterial in nature and that the disease is produced by some indirect effects of the causative organism situated, probably, at regions more or less removed from the joints actually involved. Many bacteria have been considered as the cause of the disease, but it seems probable that different strains of the streptococcus are the chief factors. The manner of influence is apparently through a mechanism known as ALLERGY by which the joint and other tissues are "sensitized" to the organism or the products of its growth.

The onset of rheumatic fever is usually abrupt and

the disease may run a protracted course. The primary focus of infection is probably chiefly in the tonsils, and removal of the tonsils may be regarded, therefore, as a preventive measure, serving also to forestall recurrence. Treatment of the disease requires complete rest in bed, the use of salicylates to overcome the rheumatic symptoms, and the prolongation of the period of convalescence long after apparent recovery has occurred in order to avoid damage to the heart. The joints become acutely swollen and tender, but, fortunately, permanent damage to them does not necessarily occur. During the course of the disease the joints should be protected from movement and pain by splinting. With early diagnosis and proper care, the prognosis is usually good. (*See also* HEART DISEASE, PERICARDIUM, DISEASES OF.) R. PE.

RHEUMATISM, the term used to designate, vaguely, a group of symptoms characterized chiefly by pain or stiffness due to inflammation of the muscles, tendons, joints and nerves. Under this loose classification are placed rheumatic fever, arthritis, and certain disorders of muscles and nerves known as myositis and neuritis respectively. There are other disturbances of joints which give somewhat comparable symptoms, such as those due to tuberculosis and injury, but these are treated elsewhere. *See* ARTHRITIS; MYOSITIS; NEURITIS; RHEUMATIC FEVER.

RHEYDT, a city of Germany about 20 mi. west of Dusseldorf. It is in the former Prussian Rhine province. There is a flourishing textile industry, particularly in cotton and half-woolen goods, silk and velvet. Rheydt also has electro-technical, shoe and machine factories and many other diversified industries. It united with Munchen-Gladbach in 1929. Pop. 1925, 45,095.

RHINE, the leading commercial river of western Europe, and largest German stream. Its entire length of 810 mi. runs generally north and finally curves west to empty into the North Sea after traversing west Germany and Holland. Its headwaters, the Hinter Rhein and the Vorder Rhein, which rise in the southern Swiss Alps, unite at Reichenau and form the river proper. The waterway courses north as the boundary between Switzerland and Austria to Lake Constance, entering at the east and emerging at the west. After receiving the Thur and Aar, the river encounters at Schaffhausen the Falls of the Rhine which descend imposingly for 70 ft. as it flows west rapidly to form the boundary between Switzerland and Germany as far as Basel. Then it winds north along a wide plain on its way through the valley between the Vosges Hills and the Black Forest, carving a very narrow and deep channel as it passes the fabled Lorelei rocks and forms the boundary between France and Germany. This region comprises countryside so fertile, with densely wooded hills rising behind a very rich and productive farming area, that it is known as the "Garden of Germany."

The stream then proceeds past Strasbourg, France, and enters western Germany, where on its banks are the important cities of Mannheim, Worms and Mainz.

The principal affluents in this section are the Ill, Neckar and Main. From Mainz northwest to Bonn lies the most celebrated of the Rhine regions. At Coblenz the Lahn and the Moselle discharge into the Rhine; this portion is noted for the vineyards whose grapes produce some of the world's finest white wines. Throughout this part, the river winds about steep cliffs which rise up, often from the very edge of the water, their slopes verdant with fine vineyards and their summits crowned with the ruins of glorious old castles, among them the Thurnberg, Cat, Rheinstein, Rheinfels and Ehrenberg, affording a constantly shifting panorama. This is the country beloved of tourists. Every castle has its legends, all associated with the history of the vicinity. As the Rhine nears Cologne it widens, coursing through flat country to approach the lowlands of Holland. At Dusseldorf the river receives as chief affluents the Lippe and the Ruhr. It turns west to enter Holland and divides into two arms which debouch through the Hook of Holland and the Zuider Zee into the North Sea, receiving local names in various portions of their course. The Rhine's largest tributary in Dutch territory is the Maas, or Meuse. Of the river traffic, 75% passes through the great commercial port of Rotterdam situated near its mouth.

Canals connecting the river with the Danube, Rhone, Marne, Meuse, Seine, Saone and Ems add to its value as a trade route, the Ludwigskanal, between the Danube and the Rhine, is the best-known of these. Green slopes beneath the sharp crags of lofty peaks, picturesque medieval villages and moldering castle ruins of romantic loveliness in proximity to industrial centers of the most modern type all combine to give the Rhine basin a unique atmosphere and variety of scenery. The valleys are the most populous of all Europe. The stream flows past regions rich in minerals and discharges into a sea busy with traffic, to which its boats for the most part bring coal, ores and grain. There is also steady passenger traffic, particularly between Mainz and Dusseldorf. Numerous railways intersect it throughout its course. The riverbed itself is continually being improved to keep it open for navigation. German literature is rich in allusions to the river, from the time of the Niebelungenlied to our own day.

RHINE, CONFEDERATION OF THE, a union of German princes set up by Napoleon in 1806. The principal states comprising it were Bavaria, Wurttemberg, Baden, Hesse-Darmstadt, Berg and later all except Austria, Prussia, Brunswick and Hesse. These states had been made considerably more powerful by Napoleon, who granted them political dominion over territories formerly ruled by the great bishops and the lesser princes. For this reason Napoleon counted on their loyalty and really enjoyed it until the Battle of Leipzig, Oct. 16, 1813, broke his power in Germany. Members of the Confederation enjoyed independence in internal affairs; but their foreign policy was unified and in the hands of Napoleon, the Protector. The Confederation wiped out the an-

cient Holy Roman Empire and ended the petty states of western Germany, laying down the boundaries substantially as they exist to-day.

RHINELAND. Except for Alsace-Lorraine which France recovered in the treaty of Versailles, both banks of the Rhine are populated by Germans and form part of the German Reich. This condition violates the French conception of natural frontiers. As a result of the war of 1870-71, however, Germany extended its hold upon the Rhineland by annexing the two French provinces of Alsace-Lorraine—an annexation which was prompted by strategic motives. Bitterly protesting against this annexation, the elected representatives of Alsace-Lorraine in 1871 unanimously declared their desire to remain French; and the population as a whole remained hostile to German rule down until the World War. It was the question of Alsace-Lorraine which remained the one outstanding obstacle to Franco-German rapprochement after 1871, and it was a foregone conclusion, emphasized by President Wilson's 14 Points that Alsace-Lorraine would be returned to France in case of an Allied victory in the World War. Despite the return of these provinces the problem of Alsace-Lorraine is not entirely solved. The people of these provinces wish to maintain their local patois and institutions, they wish to maintain Catholicism as an official religion. The French government on the other hand has been inclined to apply to the provinces the regime of civilization and anti-clericalism found in France. In the Locarno agreement, Germany formally undertook to respect the present status of Alsace-Lorraine, so that the problem has ceased to be international and is now purely internal.

Treaties. In addition to returning Alsace-Lorraine to France, the treaty of Versailles diminished the German control on the Rhineland area in a number of other respects. Thus it obliged Germany to cede to Belgium, after the formality of a palpably unfair plebiscite, the little enclaves of Eupen and Malmédy and to renounce in favor of the League of Nations the government of the Saar valley, an area 90% of whose inhabitants are German. At the same time Germany ceded the ownership of the Saar coal mines to France. This territory is administered by an international commission appointed by the Council of the League of Nations, and in 1935 a plebiscite is to determine whether the population wishes to return to Germany. Although France originally wished to annex the Saar, she finally agreed to this compromise.

In addition to these territorial changes, the Treaty of Versailles imposed severe demilitarization provisions upon the Rhineland. The left Bank is permanently demilitarized and Germany is forbidden to maintain or construct any fortifications either on the left or the right bank to the west of a line drawn 50 kilometers east of the Rhine. Nor can the Reich maintain armed forces, either permanently or temporarily in this area or undertake any "permanent works for mobilization" there. A violation of these

provisions is to be declared a hostile act, "calculated to disturb the peace of the world."

Finally, the treaty of Versailles authorized the Allied governments to occupy the left Bank of the Rhine, together with the bridgeheads, for a period of 15 years, or until 1935, as a guarantee of the execution of the treaty. Nevertheless, if Germany lived up to the treaty, the Cologne area would be evacuated at the end of five years; and the Coblenz area at the end of 10 years; leaving the Mainz area to be evacuated at the end of 15 years. If the Reparation Commission, however, should find that Germany had refused to observe its obligations, the Rhineland might be reoccupied. In the spring of 1924 there were 200,000 troops in the Rhineland, of which the great majority were French. Originally American troops participated in the occupation but they were withdrawn in January, 1923. In the Rhineland agreement of June, 1919, Germany consented to the establishment of an Inter-Allied Rhineland High Commission with power to issue ordinances for the requirements of the occupation; the civil administration, however, remained in the hands of the German civil authorities. This Allied occupation of German soil necessarily aroused friction, particularly because of the presence of French colored troops.

Following the majority decision of the Reparation Commission that Germany was in default on its reparation obligations, the French and Belgian governments in Jan. 1923 occupied another portion of the Rhineland, consisting of the Ruhr valley. This occupation caused a tense situation not only in the Ruhr but in the areas previously occupied by Allied troops. It was charged that the French encouraged a separatist movement the object of which was an autonomous or independent Rhineland. Tension was relieved only by the evacuation of the Ruhr in July, 1925 following the entry into effect of a new reparation agreement, popularly known as the Dawes plan.

Realizing that a political settlement between France and Germany was essential to European peace, the leading powers met at Locarno in Oct. 1925. At this conference a number of historic agreements, the LOCARNO TREATIES, were drawn up. These did much to clear the political atmosphere and encourage an attitude of mutual trust and cooperation. Animated by the Locarno spirit, the Allied governments evacuated the Cologne area of the Rhineland in Jan. 1926. At the time of the formation of the Young plan, still further reducing Germany's obligations, the Allied governments in 1929 signed another agreement, agreeing to evacuate the remainder of the Rhineland as soon as the Young plan "is ratified by the French and German Parliaments." Such evacuation was completed by June, 1930. This evacuation thus took place five years before the date fixed in the Treaty of Versailles. Nevertheless Germany remains bound by the demilitarization provisions of the Treaty of Versailles, and Germany and France both are parties to the Locarno agreements and to the League of Nations.

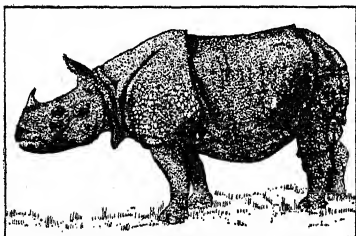
So long as the agreements are observed, the Rhineland will not trouble Franco-German relations.

R. L. Bu.

BIBLIOGRAPHY.—A. Fabre-Luce, *Locarno—The Reality*, 1928; M. S. Wertheimer, "The Evacuation of the Rhineland," *Foreign Policy Association Bulletin of Information*, Vol. V, No. 1, 1929; "Alsace-Lorraine, A Border Problem," Vol. V, No. 25, *Foreign Policy Association, Information*, Feb. 19, 1930; R. L. Buell, *Europe—A History of Ten Years*, rev. edition, Chaps. IV and VI, 1930.

RHINELANDER, a city in northern Wisconsin, the county seat of Oneida Co., situated on the Wisconsin and the Pelican rivers, 65 mi. north of Wausau. Two railroads serve the city. There is an airport. Timber and potatoes are the chief products of the vicinity. The city has various manufactures, including lumber, paper and refrigerators. Rhineland was founded in 1882 and chartered as a city in 1894. Splendid pine forests and many lakes are the charm of this region. Pop. 1920, 6,654; 1930, 8,019.

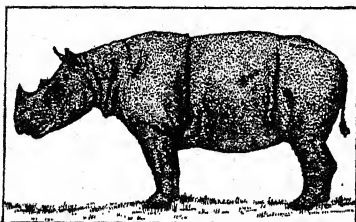
RHINOCEROS, a large mammal of the Asiatic and African family *Rhinocerotidae*. These animals belong to the solid-hoofed order, with the horses and tapirs, but have three-toed separate hoofs on all feet. The rhinoceros is distinguished by its heavy, short-legged body, thick hide, and particularly by the horn or horns on the nose. These are composed of agglutinated bristles fixed upon the massive nasal bones but growing from the skin, without bony cores. Five species of rhinoceros are known, survivors of an ancient, widely distributed race now almost extinct.



COURTESY AMER. MUS. OF NATL. HISTORY

INDIAN RHINOCEROS

The Asiatic rhinoceros (*Rhinoceros unicornis*), limited to the forests of northeastern India, is clothed in a hairless armor of thick plates of hide hinged together at the creature's joints; it has one straight horn.



COURTESY AMER. MUS. OF NATL. HISTORY

SUMATRAN RHINOCEROS

The hairy-eared or Sondaic species (*R. sondaicus*) inhabits Bengal and the Malayan islands; it is covered with a thick growth of short brown hair, and has two short, conical horns. A third species (*R. suma-*

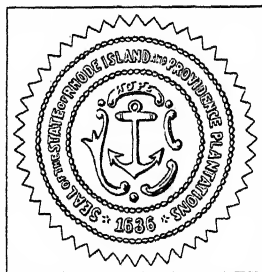
trensis), inhabiting Assam, Sumatra and Borneo, is also hairy, and has two formidable nose-horns. All dwell in deep jungle or swamps, and are wholly vegetarian.

The African species are two—the square-lipped, which is a grazer (*R. simus*) and nearly extinct; and the two-horned (*R. bicornis*). Both are smooth-coated and gray, and possess long and very effective horns. The latter species is represented by specimens in many American parks, some of which have lived as captives 50 to 75 years. The two-horned rhinoceros is still numerous on the open plains of eastern Africa, where it feeds at night on the leaves and twigs of bushes. It goes about sparingly by day and easily becomes panic-stricken. If then disturbed it will often rush straight toward what has disturbed it; but in most cases this charge is an effort to escape something dimly understood, rather than an attack, and the beast will plow through a line of carriers, but hurting no one.

E. I.

RHINOCEROS BEETLE (*Dynastes tityus*), a large, scarabaeoid beetle, found mostly in the southern Atlantic states. It has a stout body, nearly $2\frac{1}{2}$ in. long; the male insect has two long horns located on the head and on the thorax. The eggs are laid in rotting wood, on which the larva feeds. Both larva and adult have a strong, disagreeable odor.

RHODE ISLAND, a New England State, one of the original thirteen states of the Union, popularly called "Little Rhody." It is situated between $41^{\circ} 18'$ and $42^{\circ} 3' N.$ lat. and $71^{\circ} 8'$ and $71^{\circ} 53' W.$ long. On the north and east it is bounded by Massachusetts, on the south by the Atlantic Ocean, and on the west by Connecticut. Rhode Island comprises an area of 1,248 sq. mi., inclusive of 181 sq. mi. of water surface. In size Rhode Island ranks forty-eighth among the states of the Union.



RHODE ISLAND STATE SEAL

Surface Features. The surface of Rhode Island is a hilly upland which slopes toward the sea. Its mean elevation above sea level is 200 ft. and its highest point is 805 ft. on Durfee Hill in Providence Co. The state has 118 mi. of coast line including that along Narragansett Bay which extends 28 mi. inland. Within the bay are several islands, the largest of which are Conanicut, Prudence, and Rhode Island from which the state gets its name. Block Island lies a short distance off the coast.

Climate. Owing to Rhode Island's sheltered position, the climate is mild and exhibits few variations in temperature. The annual mean temperature at Providence is $49.8^{\circ} F.$, ranging from a mean of $27.2^{\circ} F.$ for January to $73.4^{\circ} F.$ for July, with an annual precipitation of 39.2 in. including 32.9 in. of snow.

Forests and Parks. The forests which originally covered 94% of the land area of the state, or 640,000 acres, include all the principal deciduous trees,—oak, hickory, chestnut, beech, maple, tulip, elm and ash, also white pine, hemlock and some red spruce. Second-growth forests cover 250,000 acres and the Bureau of Forestry is taking active measures to create interest in further reforestation. There are no state-owned forests. An extensive system of municipal parks ranging in size from less than an acre to 458 acres in Lincoln Woods and 472 acres in Goddard Memorial Park have been established primarily for recreational use. These parks comprise baseball and football grounds and bathing beaches. Trails and bridle paths have been developed and year-round camping is permitted. The parks are widely used for snowshoeing, skiing, skating and sledding during the winter months. All of the municipal parks are game refuges. A state game farm has been operated since 1925 and devotes its activities chiefly to the breeding of pheasant and quail.

Minerals and Mining. As a producer of minerals Rhode Island is restricted chiefly to the output of a small number of quarries and sand and gravel pits. The state ranks first, however, in the production of amorphous graphite. With a mineral output in 1929 amounting to \$939,602, Rhode Island stood forty-seventh among the states. The leading products were granite, valued at \$683,053, and sand and gravel, \$154,390. During 1929 14 mines and quarries gave employment to 301 persons who received \$455,030 in salaries and wages.

Soil. Composed chiefly of boulder clay or hard pan the soils are of little value for agriculture. About one-fifth of the total area of the state has a general-farming soil devoted in the main to pasture and hay production, with a limited acreage suitable for growing cereals, garden truck and potatoes.

Agriculture. Rhode Island, ranking last among the states in agriculture, produces chiefly vegetables, hay and fruit.

In 1930 279,361 ac. or 40.9% of the entire land area was in farms, 3,322 in number, with an average size per farm of 84.1 ac. and an average value per acre of \$123.52. Of the farm area 68,256 ac. was crop land; 100,432 ac., pasture land; and 83,735 ac., woodland. The total value of farm property was \$41,111,441, of which \$34,597,749 was represented by land and buildings; \$2,718,369, by implements and machinery; and \$3,885,323, by dairy cattle and other domestic animals.

According to the census of 1930 Rhode Island produced in 1929 field crops to the value of \$3,020,724, ranking forty-eighth among the states. The chief crops were vegetables, \$1,248,811; hay and forage, \$1,098,995, and fruits, \$552,292. The leading vegetables were potatoes, \$426,891; sweet corn, \$107,220, and tomatoes, \$71,658; the chief fruit crop was apples, 261,905 bu. Farm products sold by cooperative marketing rose from \$222,078 in 1919 to \$307,824 in 1929. Farm machinery and equipment in 1930 in-

cluded 2,569 automobiles, 1,701 motor trucks and 589 tractors.

Animal Industry. Milk and eggs are the chief animal products. According to the census of 1930, Rhode Island ranked forty-eighth among the states in total value, \$3,885,323, of domestic animals on farms. Among these were cattle, 31,633, valued at \$2,959,475; horses, 3,199, \$400,494; swine, 4,811, \$71,864, and sheep, 3,060, \$26,607.

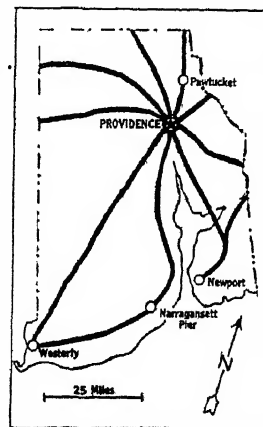
Of the cows on farms 21,694 were kept mainly for milk production and 424 mainly for beef production. In 1929, 14,889,788 gals. of milk were produced; the total value of dairy products marketed, mostly whole milk, was \$4,545,328. The value of all poultry raised, chiefly chickens, was \$1,060,746; the chickens sold were valued at \$525,327. Of 2,468,706 doz. chicken eggs produced, valued at \$1,218,390, 1,898,784 doz., with a value of \$935,934, were marketed.

Fisheries. The commercial fisheries of the state are important, the catch of 1930 amounting to 28,401,000 lbs., valued at \$2,435,000. Oysters are the most valuable single catch, followed by scup, lobsters, squeteague, flounder, menhaden, clams, butterfish, and scallops. There is little inland fishing. In 1930, 13,438 fishing licenses were issued, and \$15,804 received in fees. Two fish hatcheries were operated by the state at a cost of \$22,449. The year's output was 22,764 trout and 19,000 bass. In addition, the U.S. Bureau of Fisheries distributed 20,000 brook trout in state waters.

Transportation. Coastwise communication by water routes is afforded by the ports of Providence, Newport, Pawtucket, Bristol and others. However, with the exception of Providence, lack of harbor and terminal facilities handicap the development of a heavy traffic volume.

The New Haven railroad, which controlled practically all of the 196 mi. of railway in Rhode Island in 1930, carries the bulk of the region's manufactures to New York City.

The state's highway system has been carefully maintained and gradually extended. On Jan. 1, 1930, there were 3,707 mi. of highways, including 1,025 mi. of surfaced roads and 533 mi. of improved state highways. During 1929, highway expenditures were \$5,879,360, of which \$4,949,402 was paid by the state and \$929,858 by county and local governments. Gasoline consumption in 1930 aggregated 88,832,000 gals. The state gasoline tax produced an income that year of \$1,735,747 as against \$511,896 in 1926. Motor vehicle registrations were 136,423 in 1930 compared with 101,756 in 1925. The growth of transportation by truck is indicated by registrations which rose



RHODE ISLAND STATE ROADS

from 17,419 in 1925 to 19,631 in 1930. During the same period the number of buses in operation increased from 187 to 394, or over 110%.

Manufactures. Rhode Island has long been almost exclusively a manufacturing state, devoted largely to the production of textiles through the use of abundant water power.

According to the Census of 1930 Rhode Island with manufactures for 1929 valued at \$666,368,210 stood twenty-fourth among the states. Its 1,701 establishments gave employment to 14,048 officers and employees, who received \$38,701,802 in salaries, and to 126,068 wage earners, who were paid \$144,196,934 in wages. These factories used a total of 463,822 horse power, expended \$14,270,915 for fuel and power and \$328,019,156 for materials and supplies, and added by the process of manufacture \$324,078,139 to the value of their output.

In this output there were enumerated 79 separate groups of manufactures. The state stood second in worsted goods, jewelry and lace goods; third in textile machinery; fourth in dyeing and finishing textiles, and sixth in cotton goods, silk and rayon, and woolen goods. Among the chief manufactures with their value were worsted goods, \$138,197,177; cotton goods, \$86,203,795; dyeing and finishing textiles, \$51,394,741; jewelry, \$41,692,203; silk and rayon, \$35,638,421; cotton small wares, \$19,332,244; electrical machinery, \$18,208,435; textile machinery, \$18,009,718, and woolen goods, \$16,789,514.

The principal manufacturing cities with value of output were Providence, \$240,549,196, Pawtucket, \$112,467,353, and Woonsocket, \$81,057,780.

Commerce. According to the census of 1930, there were in 1929, 738 wholesaling establishments in Rhode Island, with total sales of \$300,688,570. These organizations gave full-time employment to 8,126 men and women whose annual salaries and wages aggregated \$14,940,799. The chief wholesaling center is Providence.

The total sales of the 9,488 retail stores amounted to \$316,573,174. Sales per store averaged \$33,366; sales per capita were \$460.47.

CHIEF RETAIL DISTRIBUTING GROUPS

Group	No. of Stores	Sales	% of Total
Food	3,858	\$84,059,527	26.55
Automotive	1,326	53,547,662	16.93
General Mdse. . .	453	44,553,587	14.08
Apparel	762	29,632,948	9.36
Lumber & Bldg.	441	25,063,664	7.92
Furn. & Household	247	14,690,415	4.64
All other stores	2,401	65,025,371	20.52
Total, all stores	9,488	\$316,573,174	100.00

Finance and Banking. The assessed value of all taxable property in 1929 was \$1,393,742,141. The gross bonded state debt on Nov. 30, 1929 was \$22,684,000, less a sinking fund of \$4,284,854, leaving a net bonded debt of \$18,399,146. The total state revenues in 1929 were \$15,471,248; total disbursements, \$13,035,608. The chief sources of income were

property taxes, \$8,725,080, and taxes on corporation franchises, public service corporations, motor vehicles and gasoline sales, \$1,441,128. The principal payments were for highways, \$4,442,115, permanent improvements, \$1,636,701, debt service, \$882,774 and educational aid, \$475,857.

There were 63 banks in Rhode Island in 1930. Of these, 10 were national banks and 53 trust companies and state banks. Their total capitalization was \$17,400,000, their surplus and undivided profits, \$51,754,000. Total resources were \$596,846,000, with loans and discounts aggregating \$303,841,000. Demand and time deposits totaled \$504,612,000. Per capita demand and time deposits were \$730.26; per capita savings deposits, \$534.52. The total savings of \$369,350,000 were owned by 407,130 depositors. National bank circulation aggregated \$3,309,000.

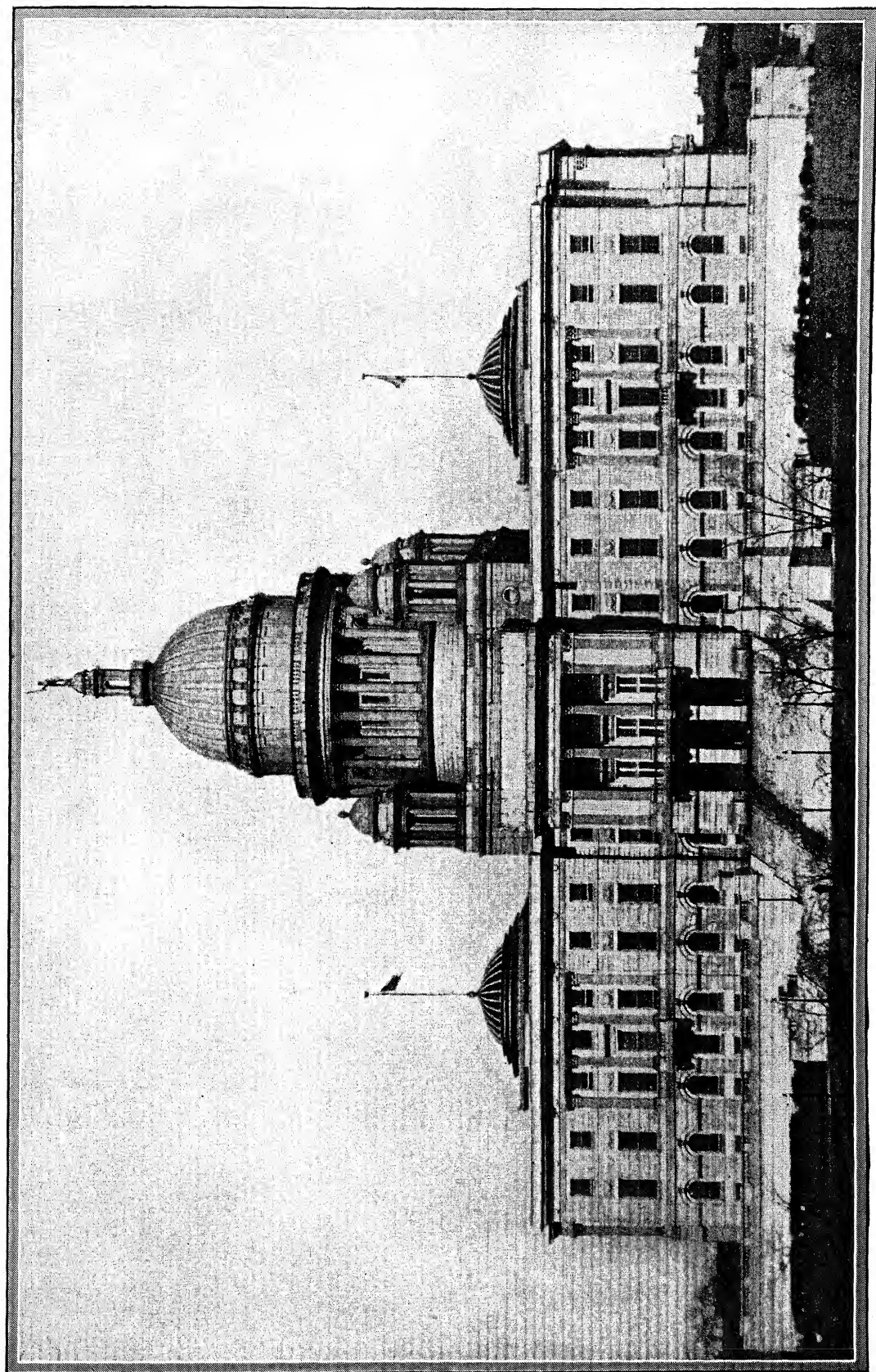
Government. The legislative body of Rhode Island, known as the General Assembly, consists of a Senate composed of 39 members and a House of Representatives of 100, all elected for terms of two years. They meet in annual sessions limited in duration to 60 days. The chief executive is the governor, elected for a term of two years at a salary of \$8,000 per year. He has the power of veto. Other executive officers are the lieutenant governor, secretary of state, attorney-general and treasurer. Judicial power is vested in a supreme court and subordinate courts. The supreme court consists of 5 judges, of whom one is the chief justice, all chosen by the legislature for life unless later removed by the legislature. The chief justice receives a salary of \$9,000 and the other judges salaries of \$8,000 per annum.

Social Welfare Institutions. Most of the state institutions for social welfare are grouped together and known as the State Farm situated at Cranston, Howard P.O. These include Oaklawn School for Girls and Sockanossett School for Boys, both of which are reform schools, a reformatory for women, an infirmary and hospital for mental diseases, and the state prison. Exeter School for feeble-minded is at Exeter, Lafayette P.O. A state hospital and school for children is at Providence. The State Public Welfare Commission supervises most of the charitable and penal institutions.

Education. The first school was founded at Newport in 1640, and there was a school at Providence in 1663. Ten years later a school was founded at Barrington. In 1800 the first general education law for the state was enacted, and free schools were opened in that year at Providence. In 1927-28, there were 2,450 public elementary schools, having 2,828 teachers and 90,783 pupils enrolled, and there were 464 high schools. Compulsory school laws require children from 7 to 15 years of age to attend school the full term.

The number of persons from 5 to 20 years of age attending school in 1930 was 144,033, or 69.7% of the population within the ages specified, as compared with 108,817, or 62.8%, in 1920. The number of persons 10 years and over unable to read and

RHODE ISLAND



EWING GALLOWAY PHOTO

STATE CAPITOL OF RHODE ISLAND AT PROVIDENCE

One of the outstanding government buildings of the United States and architecturally a splendid example of the classic style, the State Capitol of Rhode Island, completed in 1902, dominates the city of Providence and vicinity. McKim, Mead and White were the architects.

RHODE ISLAND

Area, 1,248 sq. m.
Pop. 687,497

PRINCIPAL CITIES

Pop.—Thousands

- 1 Albion... B 15
- 1 Allenton... J 13
- 1 Anthony... G 11
- 1 Apponaug... G 14
- 1 Arlington... E 14
- 1 Ashton... F 16
- 1 Auburn... F 15
- 1 Barrington... G 19
- 1 Block Island... R 12
- 12 Bristol... H 20
- 1 Centerdale... D 13
- 1 Centerville... G 12
- 1 Central Falls... C 16

- 1 Charlestown... N 8
- 1 Chepachet... N 7
- 1 Conimicut... G 16
- 1 Coventry... G 9
- 1 Cranston... E 14
- 1 Crompton... H 13
- 1 Cumberland Hill... B 13
- 1 E. Greenwich... H 13
- 30 E. Providence... E 17, P 24
- 1 Exeter... J 12
- 1 Fiskeville... G 12
- 1 Georgiaville... C 13
- 1 Greenville... D 11
- 1 Greystone... D 13
- 1 Harrisville... B 7
- 1 Hills Grove... G 15
- 1 Hope... G 11
- 1 Hope Valley... G 11

- 3 Hopkinton... K 6
- 1 Howard... E 14
- 1 Jamestown... K 17
- 1 Lakewood... F 16
- 1 Little Compton... K 22
- 1 Lonsdale... C 16
- 1 Lymanville... D 13
- 1 Manville... B 15
- 1 Middletown... J 19
- 1 Narragansett... K 21
- 1 Narragansett Pier... M 15
- 1 Natick... G 14
- 1 Newport... L 20
- 1 New Shoreham... F 11
- 1 N. Scituate... I 10
- 1 North Tiverton... H 22
- 1 Oakland Beach... H 16
- 4 Pascoag... B 7
- 77 Pawtucket... D 16
- 4 Pawtuxet... F 16
- 1 Peace Dale... I 12
- 1 Phenix... G 12
- 1 Portsmouth... I 21

- 253 Providence... E 15
- 5 River Point... G 12
- 2 Riverside... F 17
- 1 Saylesville... C 15
- 1 Slatersville... A 10
- 1 Smithfield... C 12
- 1 Thornton... E 14
- 1 Tiverton... I 22
- 1 Valley Falls... C 17
- 3 Wakefield... M 13
- 3 Warren... G 19
- 23 Warwick... H 17
- 1 West Barrington... F 18
- 11 Westerly... N 3
- 13 West Warwick... G 12
- 1 Wickford... J 14
- 49 Woonsocket... A 13

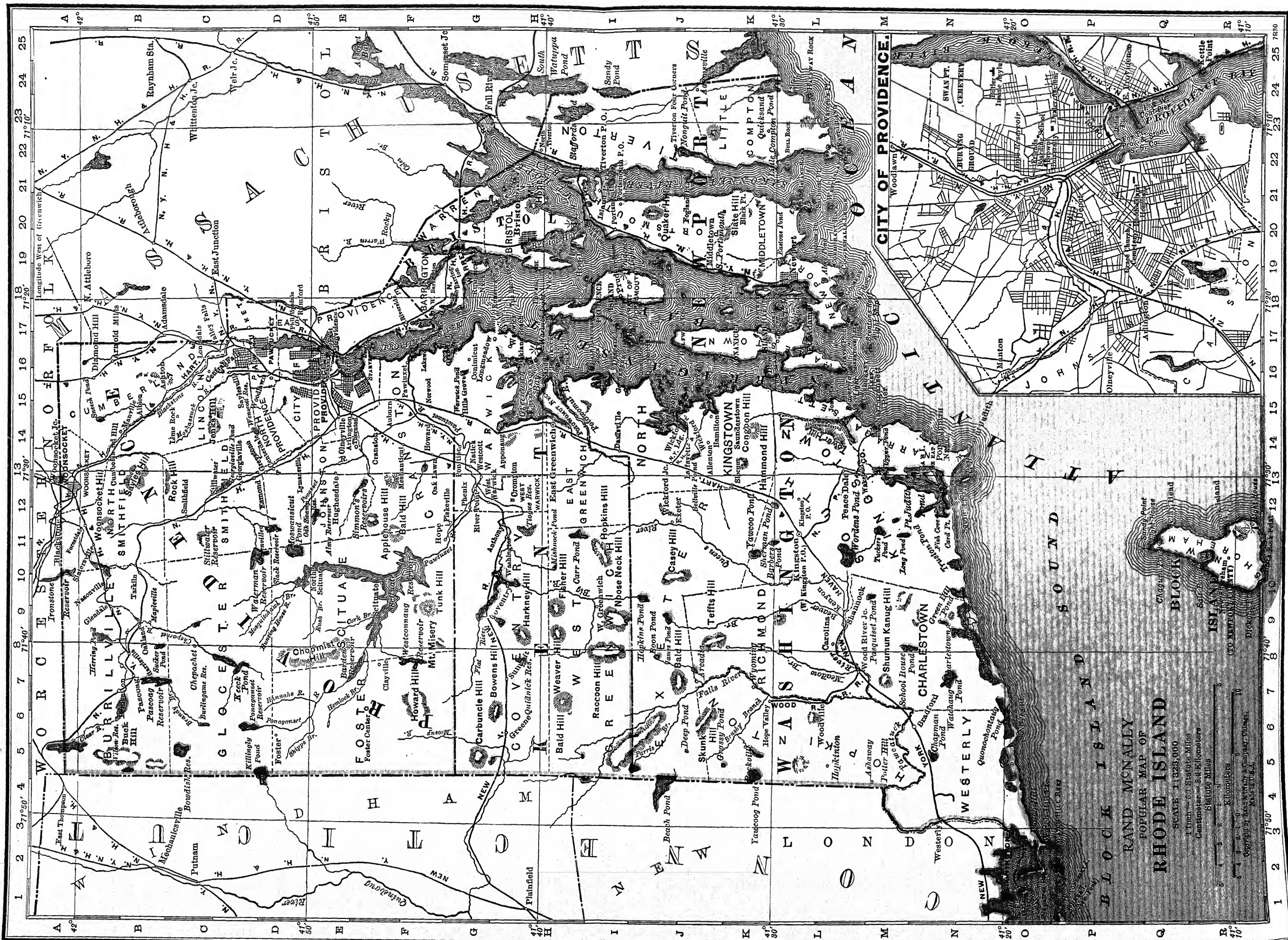
- 7 Bradford... N 6
- 7 Carolina... L 8
- 8 Forestdale... A 11
- 8 Hughesdale... E 12
- 7 Lafayette... J 13
- 7 Mashantucket... F 13
- 9 Norwood... F 15
- 8 Phillipsdale... D 17
- 8 Pontiac... G 13
- 8 South Portsmouth... K 19

- 1 Wickford... J 14
- 49 Woonsocket... A 13
- 7 Bradford... N 6
- 7 Carolina... L 8
- 8 Forestdale... A 11
- 8 Hughesdale... E 12
- 7 Lafayette... J 13
- 7 Mashantucket... F 13
- 9 Norwood... F 15
- 8 Phillipsdale... D 17
- 8 Pontiac... G 13
- 8 South Portsmouth... K 19

- 1 Wickford... J 14
- 49 Woonsocket... A 13
- 7 Bradford... N 6
- 7 Carolina... L 8
- 8 Forestdale... A 11
- 8 Hughesdale... E 12
- 7 Lafayette... J 13
- 7 Mashantucket... F 13
- 9 Norwood... F 15
- 8 Phillipsdale... D 17
- 8 Pontiac... G 13
- 8 South Portsmouth... K 19

- 1 Wickford... J 14
- 49 Woonsocket... A 13
- 7 Bradford... N 6
- 7 Carolina... L 8
- 8 Forestdale... A 11
- 8 Hughesdale... E 12
- 7 Lafayette... J 13
- 7 Mashantucket... F 13
- 9 Norwood... F 15
- 8 Phillipsdale... D 17
- 8 Pontiac... G 13
- 8 South Portsmouth... K 19

- 1 Wickford... J 14
- 49 Woonsocket... A 13
- 7 Bradford... N 6
- 7 Carolina... L 8
- 8 Forestdale... A 11
- 8 Hughesdale... E 12
- 7 Lafayette... J 13
- 7 Mashantucket... F 13
- 9 Norwood... F 15
- 8 Phillipsdale... D 17
- 8 Pontiac... G 13
- 8 South Portsmouth... K 19



RAND McNALLY
POPULAR MAP OF
RHODE ISLAND

SCALE 1:250,000
1 inch = 6.1 Statute Miles
1 centimeter = 0.39 Kilometers

Copyright by Rand McNally Company, Chicago, Ill. 1914

write in 1930 was 27,536, or 4.9%, as compared with 31,312 illiterates, or 6.5%, in 1920. Foreign-born white illiterates numbered 24,124, or 14.3%, in 1930, and 28,169, or 16.5%, in 1920.

The state maintains as institutions of higher learning Rhode Island College of Education at Providence, Rhode Island State College at Kingston, and 15 training schools for teachers. Other educational institutions include the Rhode Island School of Design, Brown University, and Providence College, all at Providence. The state library system is governed by the State Board of Education, at the State House in Providence.

Population. In 1930 Rhode Island ranked thirty-seventh among the states with a population of 687,497 or an average of 644.3 per sq. mi., an increase of 83,100 or 13.7% over 1920. The population rose from 68,825 in 1790, to 147,545 in 1850, 428,556 in 1900, 542,610 in 1910, and 604,397 in 1920. In 1930 there were 677,016 or 98.5% whites and 9,913 or 1.4% Negroes. Of the whites, 506,302 were native-born and 170,714 were foreign-born, a decrease in the latter of 2,785 from 1920. Of the total foreign stock, including foreign-born, foreign and mixed parentage, 92,036 or 19.7% were Italian; 91,173 or 19.6%, French Canadian; 58,971 or 12.7%, English; 54,911 or 11.8%, Irish. The urban population was 635,429 or 92.4% of the total; the rural, 52,068, or 7.6% of the total. In 1930 the largest cities were Providence, 252,981; Pawtucket, 77,149; Woonsocket, 49,376; Cranston, 42,911.

Occupations. In 1930 297,172 persons, or 43.2% of the population, were gainful workers 10 years old or older; 70.4% of these were males and 29.6% were females; 66.5% were native white; 31.8% foreign-born white, and 1.6% Negro. Among the chief occupations, with number of workers, were manufacturing, 151,462; trade, 36,802, clerical service, 26,938; domestic and personal service, 27,226; transportation and communication, 19,072; professional service, 18,073, and agriculture, 8,833.

HISTORY

Rhode Island was founded by expatriates from Massachusetts Bay Colony—offenders against the religious and political orthodoxy of that colony, and their followers. Providence was founded by ROGER WILLIAMS in June, 1636, Portsmouth by Antinomian sectarians, including ANNE HUTCHINSON, in the Spring of 1638. Newport was established by William Codrington and John Clark, "seceders" from Portsmouth, in April, 1639, and Warwick by a defection from Providence under Samuel Gorton in January, 1643. Complete religious toleration existed coincidentally with a large measure of political freedom. These settlements were united by a royal charter as Providence Plantations in 1644. Two confederations, the mainland towns and the island towns, existed from 1651 to 1654. In 1663 Charles II granted the notable charter to Rhode Island and Providence Plantations, which served so well that the document was pro-

tracted as a state constitution, and was not supplanted until 1784. DORR'S REBELLION expressed the vehemence of the popular demand for unrestricted male suffrage. The charter was temporarily suspended, 1686-1689, during the régime of SIR EDMUND ANDROS. As the colonial period advanced, agricultural economy was gradually overshadowed by commercial interests; Newport, in particular, became a center of legitimate maritime trade as well as privateering, smuggling and piracy. The Sugar Act of 1764, disastrous to the triangular voyages—from Newport to Africa, carrying rum; to the West Indies with slaves; thence to Newport with molasses—did most to encourage Revolutionary agitation. (See GASPÉE, BURNING OF.) Although Newport was occupied by the British during the greater part of the Revolution, Rhode Island was thoroughly committed to independence. The state was last to ratify the federal Constitution, and did so in May, 1790, only to prevent commercial losses. The legislature rotated from county to county until 1854, and until 1900 Newport shared with Providence the distinction of being the capital. The state's individualistic principles in politics have continued to be manifest. In the Presidential election of 1928 the normal Republican majority of Rhode Island was overthrown by a Democratic victory; in 1932 the state gave its four electoral votes to Roosevelt. Theodore F. Green, Democrat, was elected governor. Rhode Island has several times put itself on record as opposed to the 18th Amendment.

BIBLIOGRAPHY—I. B. Richman, *Rhode Island Its Making and Meaning*, 1636-1683, 1902, and *Rhode Island, a Study in Separatism*, 1905, C. S. Brigham, *Last of Books upon Rhode Island History*, 1908.

RHODE ISLAND STATE COLLEGE, a co-educational institution at Kingston, R.I. It was founded in 1890 as a land grant college, under the provisions of the Morrill Act of 1862, and is supported by the state and Federal government. The grounds and buildings were valued in 1931 at \$1,375,700. The library contained 31,606 volumes. In 1931-32 there were 798 students and a faculty of 52, headed by Acting Pres. John Barlow.

RHODES, CECIL JOHN (1853-1902), British statesman and financier, was born at Bishop Stortford, Hertfordshire, July 5, 1853. He went to the Kimberley diamond fields in 1870, and was a millionaire at 19. In 1873 he entered Oxford, and after a long period of illness obtained his B.A. and M.A. in 1881. He organized the De Beers Consolidated Mines, and in 1881 became a member of the Cape Parliament. He succeeded in making BECHUANALAND a British protectorate, and in 1890 formed a cabinet as Premier of the Cape Colony. Three years later, after a series of rebellions, he secured RHODESIA, 450,000 sq. mi., for the British Empire. He had an important hand in organizing the British South Africa Company. The Jameson Raid of 1896 somewhat damaged his prestige, and he resigned the premiership and as chairman of the British South Africa Co. the same year. The greater part of his fortune was left to

endow the Oxford University Rhodes scholarships for the purpose of bringing about a better understanding among English-speaking peoples. The scholarships and Rhodesia, extending from the northern frontier of the Transvaal to the borders of the Belgian Congo, are enduring monuments to the genius of the man whose remains lie buried in the hills of the provinces he added to the British Empire. He died at Muizenberg, near Cape Town, Mar. 26, 1902.

RHODES, JAMES FORD (1848-1927), American historian, was born at Cleveland, Ohio, on May 1, 1848. His formal education, which began in the public schools of his native city, was continued at New York University and the University of Chicago. An extended European trip in 1868 gave him an opportunity to register for several courses in the Collège de France, but he devoted most of his time to his duties as Paris correspondent of the *Chicago Times*. During the following year he attended lectures in metallurgy at the Berlin School of Mines. Returning to the United States in 1870 he entered upon a business career in the rapidly expanding iron industry of Cleveland. Four years later he became a partner in Rhodes and Company, the prosperous iron and coal enterprise which his father had organized. He devoted himself to mercantile affairs until 1885, when he had accumulated a fortune sufficient to enable him to retire from business responsibilities. Thenceforth his vocation was the study and writing of history. In 1891 he published the first two volumes of his *History of the United States from the Compromise of 1850*, to which he added five more volumes in the years between 1895 and 1906, bringing the narrative down to the restoration of home rule in the South in 1877. The work was received enthusiastically by scholars both in the United States and in Europe. In later years he added two volumes to the *History*; the first was a *History of the United States from Hayes to McKinley*, published in 1919, and the second, which appeared in 1922, was entitled *The McKinley and Roosevelt Administrations*. In addition to these contributions, which established his place among American historians, Rhodes published *Historical Essays* (1909) and *History of the Civil War* (1917), as well as innumerable articles in historical journals. He died at Brookfield, Mass., on Jan. 22, 1927.

RHODES, an island of the Aegean, the largest of the group known as the DODECANESE and belonging to Italy. It is 45 mi. long, has a breadth of 22 mi. and an area of 425 sq. mi. The surface is broken by small mountain ranges which occasionally attain a height of 4,500 ft. The valleys between the mountains are well-watered by streams and the slopes are covered with forests. The principal products are olives, tobacco, a variety of vegetables and grains, including wheat, barley and grapes, which are of a superior quality.

Rhodes, the capital of the Dodecanese, is the only city on the island. It rises from the shore like a huge crater and is surrounded by ruined walls. In ancient times Rhodes was one of the most celebrated of cities, especially as a center of Greek learning and

art. It was famous for the colossal statue, over 100 ft. high, which was called the "Colossus of Rhodes" and which was destroyed by an earthquake in the 3rd century B.C. Under the Romans Rhodes enjoyed a form of autonomy, but in 1309 the city was taken by the Knights of St. John of Jerusalem and held by them until 1522, when the Turks captured it. The Knights built the wall which is now in ruins and otherwise attempted to restore Rhodes to its ancient position of importance. Under the Turks the city was the seat of a pasha and the distributing center of the imports for a large number of islands. In 1912 the Italians took city and island from the Turks, and ever since they have been an Italian possession. Est. pop. 1931, city, 25,000; island, 45,000.

RHODESIA, a territory in British South Africa, named in 1895 after CECIL RHODES, extending northward from Transvaal to Belgian Congo and Tanganyika. It is bounded on the west by Angola, Belgian Congo and Bechuanaland, and on the east by Portuguese East Africa, Nyasaland and Tanganyika. The Zambesi River divides it into Northern and Southern Rhodesia.

In 1888, Lobenguela, king of the Matabele nation, entered into a treaty of peace with Britain and granted mineral concessions to a group of men who in the following year founded the British South Africa Company and immediately organized a pioneer expedition which founded the town of Salisbury in 1890. Both Northern and Southern Rhodesia were administered by the company until 1923, when Southern Rhodesia, comprising the two provinces of Matabeleland and Moshonaland, was made a self-governing British colony. In 1924 Northern Rhodesia became a Crown colony under the British government, administered by a governor and executive council. It has an area of 287,950 sq. mi. Livingstone is the principal town and the seat of government.

The colony lies in the tropics, almost entirely within the high African plateau, and stretches from the Zambesi to the southern end of Lake Tanganyika. It is as yet little developed. Many of the settlers have entered the country since the World War, and their prosperity is largely dependent upon the local market, especially for the sale of cattle and maize. The cultivation of cotton and tobacco is carried on, and citrus fruits and fiber-yielding plants do well. The inhabitants of Barotseland, a native reserve, raise a little maize and Kafir corn, and keep a few animals.

Important deposits of lead ores are found at Broken Hill. Vanadium, copper, gold and silver are mined, but the entire mineral production is subject to serious fluctuations. The principal imports are mining machinery, iron and steel goods and textiles. In recent years the exports of tobacco and lead have increased.

Although the rivers, especially the Zambesi, have some value for communication, great development may not be expected until better railroad communications are available. In some places it is impossible to use horses owing to the tsetse fly. European pop. 1929, 9,981; native pop. 1927, 1,298,651.

Southern Rhodesia, administered by a governor, executive council and a legislature, has an area of 149,000 sq. mi. and stretches from the Limpopo River in the south to the Zambesi in the north. SALISBURY is the capital. BULAWAYO, Gwelo and Untali are the other large towns. A broad belt of land over 4,000 ft. above sea level runs across the country, rising to over 5,000 ft. toward the eastern border, which itself is mountainous in character. The elevated belt is termed the "high veld." The low veld, which is troubled with the tsetse fly, lies by the Zambesi and Limpopo rivers and their tributaries. In the north-west of the colony are the famous VICTORIA FALLS.

Europeans usually feel the strain consequent upon living in the tropical climate on land below 3,000 ft. sea level. Above 3,000 ft. the climate is sub-tropical; light frosts are common in winter and the region is healthy for whites.

Most of the gold obtained in modern times has come from ancient workings. It is thought that the place was visited by Arab traders many centuries ago. Chrome ore and mica are mined in large quantities. Copper production has declined recently, but much asbestos is worked. Silver, arsenic, platinum, tin, iron, wolfram, coal and lead are also included in the mineral wealth.

Cattle-ranching predominates in the drier south-west, and adjacent to the towns is a dairying industry. Maize is the chief crop. Tobacco culture is well-established, and both Virginian and Turkish varieties are raised and exported. Citrus fruits grow well and oranges are exported to Great Britain. Est. pop. 1930, 1,092,400, consisting of 1,044,000 natives and 48,400 Europeans.

RHODES SCHOLARSHIPS, established under the will of CECIL JOHN RHODES who died in 1902, provide for a stipulated number of scholarships at Oxford University for American, English and German students. Rhodes believed that educational relationships would promote a better understanding between America, England and Germany and so secure world peace. In 1916 the trustees of the fund withheld scholarships from Germans, but these were opened to them again in 1929. There are 32 appointments available to American students each year, these being for three years' study with an annual grant of about \$2000. Candidates must be male citizens of the United States, unmarried, between 19 and 25, and must have completed two years of study at a recognized university or college. A committee of former Rhodes scholars selects the students to be sent to Oxford, scholarship in school and college, character, interest in outdoor sports and qualities of leadership being the basis for this selection. Until 1930 competitions were held in 32 states each year, these being so arranged that each state was represented two out of each three years. In 1930 a new plan was tentatively adopted. The states were grouped into eight districts of six states each. A competition was held in every state, and the two most promising candidates were selected by each state committee to appear before the district committee. From

these 12 candidates the district committee selected not more than four.

RHODIUM, a chemical element belonging to the platinum metals discovered by Wollaston in 1804. It has the chemical symbol Rh, and the atomic weight 102.91; the metal is white with a faint bluish tinge, while its salts are rose colored. An alloy with platinum is used as a thermocouple element against pure platinum for measuring high temperatures, and in making resistant vessels for chemical laboratory work.

RHODOCHROSITE, a minor ORE of manganese, rose red to brown in color, with a glassy appearance, and varying from translucent to subtranslucent. It is the carbonate of manganese, crystallizing in the HEXAGONAL SYSTEM. Vein deposits of ores of silver, lead, copper, and other ores of manganese, often carry rhodochrosite. It is found in Hungary, Germany, Belgium, New Jersey, Colorado, Montana, and Nevada. See also ORE DEPOSITS; RHODONITE.

RHODODENDRON, a large genus of handsome shrubs or rarely trees of the heath family. There are about 350 species native chiefly to north temperate regions, many of which are widely grown for their highly ornamental flowers and foliage. They are mostly small or medium-sized shrubs bearing evergreen or deciduous, entire leaves and usually very numerous showy flowers in terminal, umbel-like clusters. By many those with deciduous leaves and funnelform flowers are called azaleas, while those with evergreen foliage and bell-shaped flowers are regarded as the true rhododendrons. Some of the azaleas, however, are evergreen and various rhododendrons are deciduous. Rhododendrons occur in greatest variety in China and the Himalayas.



RHODODENDRON

Sixteen species are native to North America. Among these are the great laurel (*R. maximum*), the mountain rosebay (*R. catawbiense*), the California laurel (*R. occidentale*), the rhodora (*R. canadense*), the pinxter-flower (*R. nudiflorum*) and the flame azalea (*R. calendulaceum*). Upward of 50 species, together with numerous varieties, races and hybrids, are in cultivation.

RHODONITE, a brownish red to rose pink mineral used as a minor manganese ORE, and as an ornamental stone. It is the silicate of manganese, crystallizing in the TRICLINIC SYSTEM. With RHODOCHROSITE, it is found in veins with other manganese, and zinc, copper, silver and lead ores. Ornamental masses come from Russia. Rhodonite is also found in Sweden, Hungary, Italy, Mexico, Montana, and Colorado. See also ORE DEPOSITS.

RHODORA (*Rhododendron canadense*), an elegant small shrub of the heath family common in woods in northeastern North America. The slender

branching stems grow 1 to 3 ft. high bearing oval or oblong, somewhat hairy leaves and terminal clusters of attractive rose-purple flowers, preceding or appearing with the leaves.

RHOMBOHEDRAL DIVISION, of the **HEXAGONAL SYSTEM**, in **CRYSTALLOGRAPHY** a system in which minerals are said to crystallize when they belong in the hexagonal system, but due to a lack of certain elements of symmetry, only half the normal number of faces occurs. The rhombohedron is a typical shape for crystals in this division.

RHÔNE, an important European river, and one of the four great water highways of France. Rising in south central Switzerland at an alt. of 5,909 ft., it descends a gorge and traverses a widening valley to the Lake of Geneva. The river flows through the lake, is joined by the Arve, and 12 mi. south of the city of Geneva enters France, passing through the Jura mountains. Between the frontier and the city of Lyons it receives several tributaries the Ain being the chief. Not before reaching Lyons is the Rhône practicably navigated. Below Lyons it is an age-old artery of communication, settlement, conquest and commerce. It is joined here by the Saône, which reaches due north through a rich region to its source in the Vosges mountains and forms the continuation in France of the Rhône and is its outlet of northern communication. For purposes of commerce the two make one long stream navigable for 530 mi. Through the Saône which has been joined by the Doubs the Rhône has canal connection with the basins of the Seine, Loire, Rhine and Moselle. Below Lyons its chief tributaries are the Ysère, Drôme, Aygues, and Durance rivers. The principal towns are Vienne, Valence, Avignon, Tarascon and Arles. With a wide delta it flows into the Mediterranean west of Marseilles.

RHUBARB, a numerous genus (*Rheum*) of perennial herbs of the buckwheat family. There are about 25 species, natives of northern Asia, several of which are grown as ornamentals for their striking foliage, as medicinal plants for their rootstocks, and one for its fleshy leaf-stalks used for pies and sauces. They bear clumps of very large root leaves; tall, erect flowering stems and very numerous small, whitish flowers often in profuse, showy clusters. The garden rhubarb (*R. Rapaonticum*), called also pieplant and wine-plant, is a native of Siberia and widely cultivated in numerous varieties for the thick, juicy, acid leaf-stalks cooked and eaten in early spring. While the roots of the garden rhubarb were long used medicinally the rhubarb of the drug trade is now obtained chiefly from a Chinese species (*R. officinale*) imported from the Orient. The palmate rhubarb (*R. palmatum*), of northeastern Asia, is grown for its bold, deeply lobed leaves and attractive flowering panicles.

In cultivation a well drained rich soil gives best yields of garden rhubarb. Outdoor rhubarb may be forced during late winter by inverting barrels over the plants and packing the outsides with fresh horse manure. On a large scale forcing is done by cover-

ing rows in the field with temporary steam heated hotbeds during winter or sun warmed ones in early spring. Rhubarb is also extensively forced in greenhouses, the mature roots being dug in autumn and planted usually beneath the benches.

RHUS, a large genus of trees and shrubs of the cashew family many of which are commonly called **SUMACH**. There are about 150 species native to temperate and subtropical regions of which 20 or more are found in the United States. Several yield valuable economic products; some have poisonous foliage, and a few are grown for ornament. They are mostly small shrubs 6 to 10 ft. high, though several treelike species attain a height of 30 ft. Among the more important species are the tanning sumach (*R. Coriaria*) of southern Europe, the lacquer-tree (*R. vernicifera*) yielding Japan lacquer, and the Japanese wax-tree (*R. succedanea*). See also **LEMONADE BUSH**; **POISON IVY**.

RHYME, in versification, a literary device consisting of the agreement in the terminal sounds of two or more words; generally, a piece of rhymed verse. In the ancient quantitative verse, rhyme was used only accidentally. Old English and Welsh poetry used alliteration, the agreement of initial letters. For a perfect rhyme there must be disagreement between the initial letters of the first of the rhyming syllables, as in "wake" and "sake," "killing" and "willing." There are two kinds of rhymes: the masculine, in which there is agreement only in one syllable, and the feminine in which two or more syllables agree. Poetic license allows occasionally for the use of assonance, the agreement of the vowels but not of the consonants of terminal syllables. See also **VERSE**.

RHYOLITE, a dense, fine grained **IGNEOUS ROCK**, in color usually light gray, yellow or red. The crystallization is normally so fine as to require microscopic study to identify the minerals, which are mostly quartz, feldspar and some biotite, hornblende and augite. Belonging in the **FELSITE** group, they are thus the fine grained, volcanic equivalent of **GRANITES**.

Phenocrysts of quartz and feldspar are often visible, when the rock passes into a rhyolite **PORPHYRY**. The structure is sometimes cellular, due to gases included and trapped in the mass as it cooled. The rhyolites typically occur as surface **LAVAS**. Their name is from the Greek verb meaning to flow, because they so often show flow line structure.

Rhyolite is found in the western United States, especially in South Dakota, Colorado, Wyoming and California, and in Hungary, Iceland, the Alps, and on the Lipari Islands near Naples. See also **PETROLOGY**.

RHYTHM, in music, the division of a measure, or metrical unit, into smaller pulses which, while ordinarily variable, are not necessarily so. Meter is exceedingly limited in scope, rhythm is unlimited, since duple and triple meter, and their compounds, exhaust the metrical possibilities of music whereas either of these meters is susceptible of endless variation through

inexhaustible fractional divisions of the original pulse or metrical unit

RHYTHM, SENSE OF, an instinctive disposition to group sense impressions or movements by time or intensity, or both, in such a way as to derive pleasure and efficiency through the grouping. It is said to be subjective when the grouping comes from uniform stimuli or actions, such as the tick of a clock, or the movements in walking. It is said to be objective when the grouping is physical, as in music, poetry or dancing. The subjective rhythm is the more fundamental. It is a marked element in personality type, and differs greatly in different individuals. The sense of rhythm and the tendency toward inceptive rhythmic action are present in a very large part of the individual's daily life, as in conversation and all sounds from nature, in eating and most acts of skill, in feelings of effort and achievement, even in memory and imagination. Careful analysis shows that this principle operates far more extensively in man's common activities than is generally recognized. It should be clearly distinguished from periodicity which involves mere recurrence as in the tick of the clock, in that rhythm always involves grouping.

What then is the rôle of rhythm in daily life? It favors perception by grouping, serving as a biological principle of efficiency and source of satisfaction in achievement. It adjusts the strain of attention by throwing attention into effective pulsations somewhat on the analogy of the alternating current. It gives man a feeling of balance and ease in movement, and of freedom, luxury and expanse, best illustrated in music, poetry and dancing. Rhythm gives a feeling of power; it carries with it a sort of feeling of impetus. Strangely enough, rhythm both stimulates and lulls, sometimes alternately, sometimes simultaneously, in different aspects of the act, as for example in the waltz; the inception of the music stimulates to action, but once in action the dancer is carried sometimes into a state of semitrance or dreamful abandon. Much of this carrying power of rhythm is due to its deep-rooted instinctive nature. Rhythm finds resonance in the whole organism; it is not a matter of hearing or action merely, but a response of the organism as a whole. This organic response is called rhythmic impulse. It is a primary motive for play, in which it can be traced from the earliest infant pattern up to the most complicated adult sports.

Individuals differ in rhythm primarily in two respects: in the precision with which they can perceive the rhythm, and in the strength of the impulse to act rhythmically. The former is illustrated in the exactness with which members of an orchestra must play in time, the latter by the tendency of the primitive man to keep time with the foot or sway the body.

The above statement has dealt with rhythm from the psychological point of view. Practically, in life, most rhythmic experiences are due to the objective groupings in patterns within any of the sense modalities. Thus, music consists in large and essential part, of objective rhythmic patterns. The same is true of

graphic and plastic arts, in which one of the main objectives is to furnish rhythmic patterns. All nature is full of such patterns, as in the serration of leaves, the streaming of clouds, or the waves of the ocean. We also recognize rhythm in the movements of heavenly bodies, diurnal periodicities, fashions, economic panics, and countless other periodicities. In the technical sense, we should distinguish between rhythm and periodicity, in that periodicity is a simple repetition whereas rhythm is the repetition of a pattern

C E S

BIBLIOGRAPHY—C. E. Seashore, *Psychology of Musical Talent*

RIB, in architecture, an arched member projecting from the underside of a vault, or any long, narrow, projecting decorative element. Vault ribs are decorative when their material is homogeneous with and not differentiated from the material of the rest of the vault, as in English perpendicular FAN VAULTS. They are structural when the ribs are built as independent arches with the balance of the vault as a filling between them. Structural ribbed vaults are found occasionally in Roman work, namely, the so-called Temple of Diana at Nîmes, and in a simple manner, as cross ribs between the nave piers, were common in many Romanesque churches. With the development of the intersecting vault and the use of groin ribs, or arches following the lines of the intersections, by the Lombards and Normans, the way was open for the rich and structurally important ribbed vaults of Gothic architecture. A marked individual feature of English Gothic architecture was its search for vault richness by multiplying the vault ribs. See ROMANESQUE ARCHITECTURE, GOTHIC ARCHITECTURE; VAULT.

RIBBON FISH, a name given to various marine fishes with greatly elongated, much compressed, band-like bodies, especially to those of the group *Taeniotosomi*. They are large but extremely delicate deep-sea fishes with naked silvery skin and a high dorsal fin extending the whole length of the back. Although widely distributed they are nowhere abundant and rarely visit coasts. The group includes the oarfish (*Regalecus glesne*), the largest deep-sea fish known sometimes attaining a length of 20 ft., and also the dealfishes (*Trachipterus* sp.).

RIBBON GRASS (*Phalaris arundinacea* var. *picta*), a form of the reed canary-grass widely cultivated as a garden ornamental and often escaping to roadsides in the eastern United States. The flat broad leaves, 6 to 12 in. long, are prominently marked with white and yellowish stripes.

RIBBONS are NARROW WOVEN FABRICS and their construction is essentially the same as other products of this general classification; but as is the case with other highly specialized branches of the narrow fabric industry, the manufacture of ribbons has been highly developed and requires specially constructed machinery. The batten of the loom is comparatively light and special in other details, and the warp let-off mechanism is adapted to its particular requirements.

As ribbons are mostly ornamental in nature they are usually constructed of silk, rayon, or similar valuable materials or combinations of such materials. See also YARNS, SYNTHETIC.

E. J. G.

RICARDO, DAVID (1772-1823), English economist, was born at London, Apr. 19, 1772. A thorough student of economics, he published in 1809 *The High Price of Bullion, a Proof of the Depreciation of Bank Notes*. In 1817 appeared his *Principles of Political Economy and Taxation*, which established his fame as economist. Though not a social philosopher, his influence upon economic thought of his time was second only to that of Adam Smith. After retiring from business in 1818, he entered Parliament. He died at Gatcomb Park, Sept. 11, 1823.

RICE, ALICE CALDWELL HEGAN (1870-), American novelist and short story writer, was born at Shelbyville, Ky., Jan. 11, 1870. In 1902 she married the poet, Cale Young Rice. Her best known novels are *Mrs. Wiggs of the Cabbage Patch*, 1901, *Lovey Mary*, 1903, *Sandy*, 1905, *Mr. Opp*, 1909, *A Romance of Billy Goat Hill*, 1912, and *The Honorable Percival*, 1914. Successful stage adaptations have been made of *Mrs. Wiggs of the Cabbage Patch* and *Mr. Opp*.

RICE (REIZENSTEIN), ELMER (1892-), American dramatist, was born in New York City, Sept. 28, 1892. After attending high school, he was graduated with honors from the New York Law School in 1912, and was called to the bar the following year. He was dramatic director of the University Settlement in New York and chairman of the Inter-Settlement Dramatic Society. In 1914 his *On Trial* was produced in New York by Arthur Hopkins, and also in London, with great success. Other plays by Rice include *Wake Up Jonathan*, with Hatcher Hughes; *Close Harmony*, with Dorothy Parker; *Street Scene*, Pulitzer Prize Play, 1929; *Subway*, 1929, and *See Naples and Die*, 1929, *The Left Bank* and *Counsellor-at-Law*, 1931. See also AMERICAN THEATER.

RICE, HENRY GRANTLAND (1880-), American sports writer was born at Murfreesboro, Tenn., Nov. 1, 1880. He graduated in 1901 from Vanderbilt University, where he played basketball, football and baseball. After writing articles on sports for several newspapers in the South, he came to New York and was engaged in newspaper work there until 1930. Since 1915 his syndicated column "The Sportlight" has appeared in about 80 newspapers throughout the United States. In addition to newspaper articles on golf, football, and baseball, in which fields he is ranked as an authority, he contributes articles on sports subjects to magazines, broadcasts interviews with sport celebrities, and is editor of *The American Golfer*. He also produces at regular intervals "Sportlights," a motion-picture short, dealing with various aspects of outdoor games and exercise. His books include *Baseball Ballads*, *Songs of the Stalwart*, *Songs of the Open*, *The Winning Shot* (with Jerry Travers), and *The Duffer's Handbook of Golf*. He was the editor of the department of sports in the National Encyclopedia, 1932.

RICE, an annual plant (*Oryza sativa*) of the grass family grown for its seed which has been used since prehistoric times as human food and to probably a larger extent than the product of any other plant.

Though the plant is believed to be a native of India it is extensively grown mostly near the oceans in all tropical and subtropical countries of the world. Considerable areas are also devoted to it in temperate climates. In America it was first introduced by and attained considerable importance among the early colonists of Virginia, though its practical introduction occurred in 1694 in South Carolina when the captain of a vessel gave landgrave Thomas Smith of Charleston, S.C., some seed. Production so increased that only 13 years later 17 shiploads were exported. Under slave labor the industry grew until the Civil War when it was practically destroyed; but it has gradually been coming back. According to *Yearbook of Agriculture* production in the United States for 1910 was 24,510,000 bu.; for 1920, 52,066,000 bu., and for 1930 41,367,000 bu.

Under favorable conditions rice may be grown in most of the United States and southern Ontario. In time its commercial production may extend as far north as the Ohio River. At present its area extends from the Carolinas to Texas and adjacent states. It is also extensively grown in California.

In the Orient rice is usually sown in carefully prepared beds. When the seedlings are 6 to 8 in. tall the ground is kept saturated with water. Then they are transplanted to the fields. Such practise, though involving great labor, gains a uniform stand of plants, and larger yield of grain than by broadcasting. At transplanting time the field has been prepared by natural rainfall or irrigation and shallow plowing or digging so the soil is thick mud beneath a surface of water. The planters stand in the mud and set the plants 6 or 8 in. apart each way. The field is kept flooded until the plants are a foot or more tall when the water is drained off and the crop hoed. Then it is again flooded and kept in that condition until ten days before the seed is ripe, a stage indicated by the bending of the heads. It is then reaped by hand, bundled, dried and the grain removed by pounding the heads across logs by driving cattle over them or by drawing through a hatchell. The threshed grain is then spread on floors or mats, sun-dried and stored.

In the United States rice is grown in rich alluvial lands in reclaimed marshes, along rivers, tidewater lands (above salt water) and level areas that can be readily irrigated. Water is admitted by gates when wanted and kept out by levees at other times. Ditching and draining are usually necessary to a proper preparation of the soil, so as to permit early sowing, improve the quality of the grain, insure quick removal of irrigation water before harvest and favor curing of the grain. Soil preparation and sowing are the same as for wheat.

Rice is harvested when the straw begins to turn yellow. It is then placed in shocks protected from the sun by caps, to prevent breakage of kernels when

milled. Modern machinery is taking the place of the old sickle method of cutting.

Much American rice is marketed with the hulls on, partly for protection against insects and partly because most farms lack machinery to remove the hulls. Rice mills separate weed seeds from rough grain, remove the hulls and the bran, polish, grade and sack the finished product.

Commercial classifications of rice products are head (whole) rice, straights (smaller size but mostly whole grains), screenings (broken grains) in several grades, brewers' (finely broken), polish (highly nutritious flour scoured from the kernels—not rice flour) and rice hulls (the grain husks).

M. G. K.

Nutritional Value. This depends upon the form in which rice is consumed. As harvested, it is enclosed in a coarse husk and is known as rough rice, but after removal of the husk it is known as brown rice, because of the dark color of the branny coat. After removal of the bran by scouring and rubbing, the grain is dull white and is known as white or polished rice. In America, polished rice is commonly burnished to a glistening luster by rubbing with minute amounts of talcum powder and syrup, and should more properly be termed coated or glazed polished rice. The food value of polished rice is approximately the same as that of corn meal, but its proteins are less deficient in essential nutritive constituents. The bran, scoured off in polishing, is a valuable stock feed and takes with it most of the oil and phosphoric acid and some protein, but, more important, it takes also vitamin B. To Americans, this is a matter of little moment, because rice is a minor constituent of the diet and vitamin B is obtained in abundance from other foods. However, to people subsisting mainly on rice, polishing may be disastrous by rendering the diet deficient in vitamins. Hence, in the Philippines, polishing is restricted by law. However, polishing seems necessary for an extensive trade in rice, since brown rice, unlike rough rice, does not keep well because the oil in the bran turns rancid.

C. L. A.

World Trade. Rice is widely grown but the world's commercial supply is produced in countries which have a hot climate and abundant water available. The leading rice producing countries include British India with an annual production of about 35,000,000 tons; China with 30,000,000 tons; Japan with 7,000,000 tons; French Indo-China with 3,700,000 tons; Java and Manchuria with 3,500,000 tons; Siam with 3,100,000 tons; Korea with 2,800,000 tons; and the Philippine Islands with 1,200,000 tons. The production of other countries totals about 3,000,000 tons. Of the total world exports, over six million tons, British India exports about two and one-half million tons; French Indo-China, about one and a quarter million tons; Siam, about one and a half million tons; and Korea and Formosa, over a million tons. The largest importing countries include China, Japan, Dutch East Indies and Ceylon. The United States produced 41,367,000 bushels of rice in 1930. Of this amount about 10,000,000 bushels were shipped to Hawaii, Alaska

RICE PRODUCTION, U.S.

7-Year Average, 1924-30

Division	Acreage	Production (Bu.)	% of Tot. Prod.
UNITED STATES	933,000	39,645,000	100 0
LEADING STATES*			
Louisiana	475,000	17,318,000	43 7
Arkansas	172,000	8,050,000	20 3
Texas	161,000	7,234,000	18 2
California	120,000	6,825,000	17 2

and Porto Rico. Approximately 1,250,000 bushels were imported. Louisiana, Arkansas, Texas and California produce the bulk of the rice grown in the United States.

RICE, INDIAN or WATER (*Zizania palustris*), a tall, aquatic, annual grass of striking appearance, known also as wild rice. It is found in swamps from New Brunswick to Manitoba, south to Florida and Texas and also in Asia. The smooth stems grow 3 ft. to 10 ft. high bearing flat narrow leaves, a foot or more in length, and large flowering panicles, 1 to 2 ft. long, producing linear pistillate spikelets with awns sometimes 2 ft. long on their erect upper branches and drooping staminate spikelets on their spreading lower branches. The nutritious starchy seeds, which are much eaten by birds, have been extensively used for food by the Indians.

RICE INSTITUTE, a college for men and women at Houston, Tex., founded in 1891 by William Marsh Rice, who left funds for that purpose. It is privately controlled and non-sectarian. The institution was not opened until 1912. It maintains a College of Liberal Arts and Sciences, with schools of Engineering and Architecture, and offers graduate work in chemistry, physics, mathematics and modern languages. Its endowment fund in 1931 was \$10,500,000. The library contained 55,000 volumes. In 1930 the student enrollment was 1,336, and the faculty of 92 was headed by Pres. EDGAR O. LOVETT.

RICE LAKE, a city in Barron Co., northwestern Wisconsin, situated on the Red Cedar River, 60 mi. northwest of Eau Claire. Two railroads serve the city. The chief industrial interests are lumber and dairy products. The surrounding country is rich in improved farms. Pop. 1920, 4,457; 1930, 5,177.

RICHARD I (1157-99), King of England, surnamed Coeur de Lion, born at Oxford, Sept. 8, 1157. He succeeded to the throne in 1189, and immediately joined Philip Augustus, King of France, on the Third Crusade to the Holy Land. On May 12, 1191, at Cyprus, Richard married Princess Berengaria of Navarre. He won great fame for his feats of valor in the Holy Land, and after the capture of Acre, quarreled with Philip, who returned home. Richard remained in the Holy Land another year, but failed to take Jerusalem. After patching up a truce he returned to Europe only to be captured by Leopold, duke of Austria, and turned over to the Emperor Henry VI who held him for heavy ransom. He finally secured his release and reached England

in 1194. Immediately he was forced to deal with his brother John, who had been endeavoring to supplant him during his absence, and with King Philip who was eager to secure his rich continental possessions. Richard's ability as a military leader and his choice of able ministers enabled him to keep his possessions intact, but at great financial cost to his kingdom. He died of an arrow wound during the siege of Chaluz, Apr. 6, 1199.

RICHARD II (1367-1400), King of England. Born at Bordeaux, Jan. 6, 1367, he was the son of Edward, the Black Prince, and in 1377, he succeeded his grandfather, Edward III. The boy king displayed courage in meeting the Kentish insurgents, led by Wat Tyler and Jack Straw. But as his reign proceeded he became autocratic. Numerous nobles were executed and Richard banished his cousin, Hereford, afterwards Duke of Lancaster. While the king was in Ireland, Lancaster returned and seized the throne as Henry IV. In Westminster Hall, Richard abdicated and on 14th of February, 1400, so it is believed, he was murdered in Pontefract Castle. His career is the subject of a play by Shakespeare.

RICHARD III (1452-85), King of England, born at Fotheringay, Oct. 2, 1452. During the WARS OF THE ROSES, he shared the exile of his oldest brother, Edward IV, and he demonstrated loyalty and valor at Tewkesbury and Barnet. When Edward resumed the throne, Richard received many lands and titles. In 1472, he married the Earl of Warwick's daughter, Anne. On the death of Edward IV in 1483, Richard became regent, or protector, to the lawful successor to the throne, his boy nephew, Edward V. The members of the Queen's family aspired to rule, but he deposed them and placed Edward V and his younger brother in prison. In June 1483, Richard openly assumed the throne, unscrupulously ridding himself of every one that stood in his way. Soon after his seizure of the crown, the two princes were executed by his order. His outrageous acts cost him the popularity of his people, and he had to institute a reign of terror to maintain his authority. After quelling a rebellion led by the Duke of Buckingham, Richard met a more formidable foe, Henry, Earl of Richmond, at Bosworth, and met death in defeat, Aug. 22, 1485.

RICHARD DE WYCKE, ST., bishop and a preacher of the Crusades, was born about 1197 at Droitwich, Worcestershire, England. Educated at Oxford, Paris and Bologna, he was elected chancellor of Oxford University. Later he studied theology with the Dominicans at Orleans, was ordained priest and held the livings of Deal and Charring with his chancellorship. In 1244 he was created bishop of Chichester, and six years later appointed collector of the subsidy for the Crusades. By royal appointment he was made the preacher of the Crusades in London. He died at Dover, Apr. 3, 1253, and was canonized by Urban IV in 1262.

RICHARDS, CHARLES RUSS (1871-), American educator and engineer, was born at Clarkhill,

Ind., Mar. 23, 1871. He graduated in 1890 at the college of engineering, Purdue University. In 1892 Richards joined the faculty of the University of Nebraska where he became professor of mechanical engineering in 1898, and served as such until 1911. From 1911-20 he headed the department of mechanical engineering at the University of Illinois where, from 1917-22, he was dean of the college of engineering and director of the engineering experiment station. Richards was elected president of Lehigh University in 1922.

RICHARDS, THEODORE WILLIAM (1868-), American chemist, was born at Germantown, Pa., Jan. 31, 1868. Completing his advanced studies at Harvard in 1888 he studied in Europe until 1894 when he returned to teach at Harvard. In 1901 he became professor of chemistry there. Richards determined the atomic weights of many elements with great exactness, and experimented upon the compressibility of atoms. He received the Nobel Prize in chemistry in 1914.

RICHARDSON, HENRY HOBSON (1838-86), American architect, was born in St. James parish, La., Sept. 29, 1838. He graduated from Harvard University and became a student at the Ecole des Beaux Arts, Paris. The Civil War so reduced his family's wealth that he was forced to support himself while completing his education in the French capital. In 1865 he opened an office in New York, and in 1878 he moved to Boston, where most of his work was done, and where Trinity Church stands as the most notable example of his art. Although his working years were comparatively few, and his output not large, his genius had great influence on the development of architecture in the United States. After Trinity, his most celebrated structures were the County buildings at Pittsburgh, the alterations in the State Capitol at Albany, the Brattle Square Church at Boston, and the law school of Harvard University. He also designed many libraries and town halls. He died at Boston, Apr. 27, 1886.

RICHARDSON, OWEN WILLIAMS (1879-), English physicist, was born at Dewsbury, Yorkshire, Apr. 26, 1879. After studies at Cambridge University he became professor of physics at Princeton in 1906, in 1914 returning to England as Wheatstone professor of physics at King's College, London. In 1924 he was appointed Yarrow research professor of the Royal Society. His chief researches have been in the field of "thermionics," a term of his own invention, which is concerned with emission of electrons by hot bodies, and on the electron theory of matter. He was elected to the Royal Society in 1913. In 1921 he was elected president of Section A of the British Association. He was awarded the Nobel Prize for physics in 1928.

RICHARDSON, SAMUEL (1689-1761), English novelist, was born in 1689 in Derbyshire, the son of a joiner. He attended the local village school, and in his teens became a printer's apprentice in London. At 30 he was the master of his own printing shop in

FLEET STREET; he became prosperous and was appointed Master of the Stationers' Company and to other official positions. Even as a boy of 13 Richardson had been locally famed for his letter writing, and in his autobiography he tells of the young ladies of his village coming to him to have their love letters written. This gift was the source of his first novel, for *Pamela, or Virtue Rewarded* was written as a series of familiar letters which might be used as models (see PAMELA). Published anonymously in 1740, the book at once became fashionable, especially among feminine readers. *Pamela* was the story of a servant girl, and Richardson next undertook to depict the genteel young lady. The result was *Clarissa Harlowe, or the History of a Young Lady*, published anonymously in 1748. This lengthy story hinges on the seduction of the refined Clarissa Harlowe by the gallant but despicable Lovelace, and so powerfully did it affect contemporary readers that ladies of quality besought Richardson with tears in their eyes to spare the heroine. Although generally adjudged the novelist's masterpiece, *Clarissa* frequently seems slow-moving and affected to the modern reader. By request Richardson next attempted to portray a gentleman of fine feeling. *The History of Sir Charles Grandison*, published in 1753, has its critics who see in the hero only a foppish prig, and an equal number of defenders who proclaim the book second only to *Clarissa*. Richardson's other writings include *A Collection of Moral and Instructive Sentiments*, 1755, and a voluminous body of correspondence. He died July 4, 1761, and was buried in St. Bride's Church, London.

Richardson was the first English novelist to make his stories depend on the development of character rather than upon external incident. His *Pamela* ranks him also as the first to depict sympathetically and at full length a girl of the lower class. This book was also, incidentally, the starting point of Henry Fielding's career as a novelist, since his *Joseph Andrews* was begun as a parody on *Pamela*. (See FIELDING, HENRY.) Richardson's immediate influence was more strongly felt in France and Germany than in England. (See also SENTIMENTALISM.) But he was later to have his followers in that long line of English novelists who are noted for their skill in analysing feeling. For the analytical novel indeed begins with Samuel Richardson. See also ENGLISH LITERATURE.

BIBLIOGRAPHY—Austin Dobson, *Samuel Richardson*, 1902; J. W. Krutch, *Five Masters*, 1930.

RICHELIEU, ARMAND JEAN DU PLESSIS DE, CARDINAL (1585-1642). To Francois Du Plessis, seigneur de Richelieu, who came of an old, semi-noble family of Poitou, and to his wife, Suzanne de La Porte, daughter of a Parisian lawyer, there was born in Paris on Sept. 9, 1585, a third son whom they named Armand Jean. Educated at Paris, Armand was destined at first for the army. When his elder brother Alphonse, bishop of Lucon, decided to become a monk, however, it was determined that Armand should go into the Church so that the bishopric might be kept in the family.

In 1606, Armand was named bishop of Lucon by the king. As he was five years under the canonical age he journeyed to Rome to obtain the proper dispensations. There, in 1607, he was consecrated a bishop. In 1614, when, elected by the clergy of Poitou to the Estates General of that year, his tact and address caused him to come to the attention of the Queen-Mother, Marie de Medici. Through the influence of the Queen-Mother he held briefly, in 1616-17, the office of a secretary of state.

In 1622, Richelieu was made a cardinal. Two years later, the king appointed him a member of the royal council. Though Louis XIII disliked and distrusted Richelieu, so subtly did the cardinal work upon him, that, before the end of the year, the chief member of the council had been dismissed and his place taken by Richelieu.

For the next 18 years, Cardinal Richelieu was the dominating force in the administration of the French government. His policies were simple and clear. He wished to make the royal power supreme in France, and France supreme in Europe. Though his aims were plain, his methods were not. With a cunning that was almost low, a ruthlessness that was almost ferocious, a singleness of mind that was almost narrow and an indirectness that was almost tortuous, he sought his ends. Naturally, enemies rose against him, but they always failed of their purpose. Even Marie de Medici and Anne of Austria, the wife of Louis XIII, combined against him, and, on Nov. 10, 1630, they thought they had won his dismissal from the king. Before the famous "Day of Dupes" was over, however, Richelieu was in a stronger position with the king than ever. Louis might dislike him, yet he realized that no one else could do so much for France.

To make the royal power dominant in France, Richelieu found it necessary to restrict the power of the nobles, to crush the Huguenots and to centralize the administration. In putting down the fractious nobility, the cardinal seized the opportunity of conspiracies in 1626 and 1630 to imprison or execute some of the leading nobles of France. The Huguenots, who had been given strongholds and political as well as religious rights by the Edict of Nantes (1598), were an even more serious problem. After a long, grim siege, Richelieu took their chief city, La Rochelle, by force of arms (1628), received the submission of these rebellious Protestants, then pacified them by the Edict of Alais (1629) which stripped them of most of their political privileges but left them religious freedom. To strengthen the power of the king still more, Richelieu gradually reduced the rights and functions of both the local assemblies and the governors of the provinces.

While he was establishing peace at home and vindicating the royal power, Richelieu kept a watchful eye on foreign affairs. He approved the interest in sea power and in colonies which had been awakened in the previous reign, but his attention was centered on the Thirty Years War, which, since 1618, had been dragging out its course in Germany. To make France

dominant in Europe it was necessary to humble the Hapsburgs of Catholic Austria and Spain. When Richelieu entered the war, therefore, despite his position in the Church, he was on the side of the Protestants. In 1631, he began to subsidize Gustavus Adolphus of Sweden. Four years later, he brought France itself into the war. At first, things went badly, but soon the young generals, Condé and Turenne, began winning victories, and, before Richelieu died, he had the pleasure of seeing France worsting her enemies in Spain, Italy and Germany.

On Dec. 4, 1642, Richelieu died. He, more than any one else, had laid the foundation on which France and the French monarchy were to wax so great before the close of the 17th century. C. W. C.

BIBLIOGRAPHY—A J Du Plessis de Richelieu, *Testament Politique*, 1687, G Hanotaux, *Histoire de Cardinal de Richelieu*, 1893-1903, J B Perkins, *Richelieu and the Growth of French Power*, 1900, R Lodge, *Richelieu*, 1914, F C Palm, *The Economic Policies of Richelieu*, 1922, *Cambridge Modern History*, Vol IV, Ch IV.

RICHELIEU, a historical drama by EDWARD GEORGE BULWER-LYTTON, produced and published in 1839. The intrigues and plots of a hostile faction of powerful nobles, led by the Duke of Orléans and the Count of Barades are revealed to the wily Cardinal Richelieu by Marion de Larme, and are, after many exciting incidents, at last effectively crushed. A brighter thread in this somber tapestry is furnished by the love story of Julia, Richelieu's niece.

RICHEPIN, JEAN (1849-1926), French poet, was born at Medea, Algeria, Feb. 4, 1849. As a journalist he was conspicuous for his handsome person, absolute fearlessness and his audacious theories. In 1876 his book of poems, *La Chanson des Gueux*, appeared, the greatest sensation and scandal of its time, for which its author was fined and sentenced to a month's imprisonment. *Les Blasphemes*, 1884, was also notorious. After an interlude as a sailor, Richepin devoted himself to literature. In originality, variety, power and pathos he is unsurpassed. His plays, including *La Glu* and *Nana Sahib*, in which he acted the principal male rôle with Sarah Bernhardt, and *Par le glaive*, 1894, and *Le Chemineau*, 1897, have enjoyed the greatest success in France, and, in most cases, have been produced in many foreign countries. Richepin died Dec. 11, 1926.

RICHEP, CHARLES (1850-), French physiologist, introduced the term anaphylaxis, and is known for his researches in physiology and particularly for his dictionary of physiology. His name is also associated with a bandage, which consists of plaster-of-Paris to which a little gelatin has been added.

RICHMOND, a municipal borough of Surrey, England, lying above the Thames, 9 mi. southwest of London. Originally Syenes, or Sheen, and renamed by Henry VII, it grew around the royal manor house which, built and rebuilt by successive English monarchs, was finished except for a single gateway. Today Richmond is a pleasant, residential town, of terraced gardens, and rolling, wooded countryside. Richmond Park, cresting the slope and laid out by

Charles I, contains Kew Observatory, 1769, and in its confines fallow deer still roam at large. Star O'Garth House, once a resort of 18th century fashion, has become a home for disabled World War veterans. Richmond is a focal point for excursionists. Pop. 1921, 35,639; 1931, 37,791.

RICHMOND, a municipal borough in the North Riding of Yorkshire, England, well-situated in the narrow valley of the Swale, 238 mi. northwest of London. Of early foundation, it clusters picturesquely below the ruined Norman castle crowning a cliff rising sheer above the river. A 13th century Franciscan abbey tower, and, nearby, fragments of Easby Abbey survive, and in the cobblestoned market place, quaint Holy Trinity Church rings the town curfew. Modern Richmond boasts some importance as an agricultural market, and the sole railway station in Swaledale. Pop. 1921, 3,887; 1931, 4,769.

RICHMOND, a port city in Contra Costa Co., western California, situated on San Francisco Bay, 8 mi. northeast of San Francisco, adjoining Berkeley. It is served by bus lines, coastwise steamships, ferries and two railroads. Richmond is a thriving industrial community in the Eastbay District, with Standard Oil refineries, railroad and Pullman car shops, an automobile assembling plant, and factories producing plumbing fixtures, tile and roofing products. The industrial output, 1929, was worth \$58,869,916. In 1929 the retail business amounted to \$9,472,047. Deciduous fruits and vegetables are raised in the vicinity. Founded by the Santa Fe Railroad in 1900, Richmond was incorporated in 1905. Pop. 1920, 16,843; 1930, 20,093.

RICHMOND, a city in eastern Indiana, the county seat of Wayne Co., situated on the Whitewater River, 68 mi. east of Indianapolis. It is served by the Chesapeake and Ohio and the Pennsylvania railroads and two traction lines. Richmond's leading manufactures are lawn mowers, drilling machines, pianos, automatic drills, automobile accessories and farming implements. In 1929 the manufactures amounted approximately to \$30,000,000; the retail trade reached a total of \$20,647,894. The city has many fine buildings and extensive parklands, including the 185-acre Glen Miller Park. Earlham College, established in 1847, and the Eastern Indiana Hospital for the Insane are located here. Richmond was settled by Quakers in 1806 and chartered as a city in 1840. Pop. 1920, 26,765; 1930, 32,493.

RICHMOND, a city in the blue-grass region of eastern Kentucky, the county seat of Madison Co., situated near the foothills of the Cumberland Mountains, 26 mi. southeast of Lexington. Bus lines and the Louisville and Nashville Railroad afford transportation. Richmond is a metropolis for this section and a market for burley tobacco and pure-bred live stock. It is the seat of Eastern Kentucky State Teachers College, a United States District Court and the United States Trachoma Hospital. Richmond is on the Dixie Highway, originally a trail blazed in 1770 by Squire Boone, brother of Daniel Boone. In the center of the city is a sulphur spring. The Battle of Richmond, a

Confederate victory, was fought on Aug. 30th, 1862. Ft. Boonesborough, 12 mi. north, was established by Daniel Boone in 1775. Kit Carson was born here. Richmond was founded in 1798 and incorporated in 1800. Pop. 1920, 5,622; 1930, 6,495.

RICHMOND, the capital of Virginia, and former capital of the Confederate States, the county seat of Henrico Co. It is situated at the head of navigable waters on the James River, 100 mi. southwest of Washington, in the southeastern part of the State. The city is served by six railroads, two steamship lines, airplanes and bus and truck lines. The capitol was built from plans submitted by Thomas Jefferson and fashioned after those of the Maison Carrée in Nîmes, France. The building was the scene of the trial of Aaron Burr, the State Secession Convention and the Confederate Congress. Other buildings of historic interest include St. John's Church where Patrick Henry delivered his immortal "Liberty or Death" oration; the White House of the Confederacy; the homes of Chief Justice Marshall, Robert E. Lee and Jefferson Davis, and the Edgar Allan Poe shrine containing many of his original manuscripts. Richmond is the seat of the Virginia Mechanics Institute, the University of Richmond, Union Theological Seminary, the Medical College of Virginia, the Virginia Union University (colored) and other institutions. In addition, the University of Virginia and the COLLEGE OF WILLIAM AND MARY maintain extension branches here. The city has over 20 parks and several playgrounds. Nearly 35,000 Confederate soldiers and some of the Confederate generals are buried in Richmond.

Richmond's chief industry is the manufacture of plug and smoking tobacco, cigars and cigarettes. There are also factories manufacturing paper and paper products; printing, publishing, binding and engraving plants; and shops for iron and steel machinery. The factory output for 1929 was valued at \$217,996,635; the wholesale trade proper amounted to \$87,901,385; the retail trade to \$102,201,322.

Richmond was founded in 1737 by William Byrd II. It was incorporated as a town in 1742, became the capital of Virginia in 1779, and received its charter as a city in 1782. The city was made the capital of the Confederate States in 1861, and was captured by the Union forces under Grant in April, 1865. Pop. 1920, 171,667; 1930, 182,929.

RICHMOND, UNIVERSITY OF, at Richmond, Va., a coeducational institution founded in 1832 as Virginia Baptist Seminary, was chartered in 1840 as Richmond College. Closed during the Civil War, it was reorganized in 1866 and became the University of Richmond in 1921. It is privately controlled and non-sectarian. The university had an endowment in 1931 of \$2,483,310. The library contained 45,000 volumes. In 1930 there were 785 students and a faculty of 57 headed by Pres. F. W. Boatwright.

RICHTER, JOHANN PAUL FRIEDRICH (1763-1825), German writer, also known as Jean Paul, was born at Wunsiedel, Bavaria, Mar. 21, 1763. As a young man he was a school teacher, spending his

spare time in writing. His first attempts attracted little attention, but in 1793 he published a romance entitled *Die unsichtbare Loge*, which brought him wide recognition. This he consolidated with a rapid succession of stories. He himself regarded *Titan*, 1800-03, and *Flegeljahre*, 1805, as his finest achievements. His work is characterized by great imaginative fertility and by an extravagant humor which sometimes borders on the grotesque. In spite of his success, many critics consider that Richter never did himself full justice and that his powers were in advance of his actual accomplishments. He died at Bayreuth, Nov. 14, 1825.

RICHWOOD, a city in Nicholas Co., southern West Virginia, situated on Cherry River, 60 mi. east of Charleston. Bus lines and the Baltimore and Ohio Railroad afford transportation. Richwood lies in the foothills of the picturesque Allegheny Mountains, in a region which has fine tracts of timber, coal fields and farming land. The chief local manufactures are paper, lumber and wood products, especially clothespins. Richwood was founded in 1900 and incorporated in 1901; it became a city in 1921. Pop. 1920, 4,331; 1930, 5,720.

RICKETS, a chronic nutritional disorder of infants and children which is manifested especially by abnormal changes of the bones. It occurs in greatest intensity in the temperate zones and is more particularly a disorder of cities and large industrial centers, although by no means absent in rural districts. Fully one-half of bottle-fed infants show some evidences of this nutritional disorder. Italian and negro babies are especially susceptible.

Rickets has been ascribed to almost every influence which is known to be harmful to man. Recently, however, it has been shown conclusively, largely as the result of animal investigation, that the disorder is due mainly to lack of sunlight. For this reason it develops mainly in the winter months, very rarely in the spring and summer. The protective action of sunlight is not due to the visible rays, but to the short, invisible ultra-violet radiations. These radiations have very slight power of penetration and are filtered out by window-glass, so that a baby will receive none of their protective properties when kept in a room with the windows shut, notwithstanding the fact that the room may be flooded with sunlight. Another important factor in the development of rickets is artificial feeding; it develops much more frequently and more severely among babies which are fed on cow's milk than among those which are nursed.

The characteristic signs of rickets are delay in teething, sitting up and walking; enlargement of the skull and prominence of the frontal protuberances; deformity and softening of the chest wall; enlargement of the ends of the bones at the wrist; bow-legs and knock-knees. Some of these changes can be diagnosed by the Roentgen rays. The typical chemical change is a diminution in the inorganic phosphate of the blood.

Rickets rarely leads to death, unless it is compli-

cated by tetany, a nervous disorder which is characterized by CONVULSIONS. Its main significance is that it brings about deformities of the pelvic bones and thus is the cause of difficulties in child-birth which are serious to both mother and child. Recovery often comes about spontaneously with the advent of spring or summer; the child is cured, but may be left with some bone deformities, more particularly with bow-legs, knock-knees, square head, flattening of the chest and perhaps curvature of the spine.

Rickets is unique in that it is the only disorder for which we possess several specific therapeutic agents—cod liver oil, ultra-violet irradiation, irradiated ergosterol (viosterol), irradiated milk, etc. One of the best prophylactic measures is breast feeding, another is exposing the infant directly to the sun's rays as much as possible. COD LIVER OIL is a valuable specific, as is ultra-violet irradiation furnished by the mercury vapor or the carbon arc lamp which may well be used during the winter months (*see* HELIOTHERAPY; LIGHT, ARTIFICIAL, IN TREATMENT OF DISEASE). The same is true of viosterol and of milk which has been activated by subjection to ultra-violet irradiation. In view of the fact that we have these many specific remedies, it is probable that in the course of the next decennium, rickets will become much less frequent and severe. Indeed, there has been a noticeable change in this direction during the past few years. *See also* CHILDREN, DISEASES OF; Digestive and Nutritional Disorders; IRRADIATED FOODS.

A. F. H.

BIBLIOGRAPHY.—Hess, A. F., *Rickets, Osteomalacia and Tetany*, 1929.

RIDDLE, a general word for any kind of a verbal puzzle. Through the ages, the most learned and clever people in many countries have enjoyed riddles. Solving them as a parlor game was much in fashion during the late 18th and 19th centuries. Well-known writers such as Byron, Rousseau and Voltaire amused themselves by making intricate riddles. One of the oldest and most famous is the riddle of the Sphinx. "What animal is it, that in the morning goes on four feet, at noon on two, and in the evening upon three?" To which Oedipus was the first to reply, "Man, who in childhood creeps on hands and knees, in manhood walks erect, and in old age goes with the aid of a staff."

RIDER, in legislative procedure the name given to an item of legislation attached to a bill designed for an entirely different purpose. Riders are often inserted in appropriation bills since the veto of an appropriation bill is such a serious matter, possibly necessitating the reconvening of Congress, that it is the hope of those responsible for the rider that the President will accept it rather than veto the entire measure.

RIDGEFIELD PARK, a suburban residential village of Bergen Co., N.J., located on the Hackensack River, 9 mi. north of Jersey City and 8 mi. northwest of 125th St., New York City. Its transportation facilities include the West Shore and New York,

Susquehanna and Western railroads and motor bus lines. The retail trade in 1929 amounted to \$4,088,824. Pop. 1920, 8,575; 1930, 10,764.

RIDGER, or ridge "Buster," an implement for leveling parallel ridges made by a LISTER. Disk blades mounted on a sled or wheels running between the ridges pull the soil in from both sides.

RIDGEWOOD, a residential village of Bergen Co., N.J., situated in hilly wooded country 17 mi. north of Jersey City and 7 mi. northwest of Hackensack. It is served by the Erie Railroad and motor bus lines. The village is the site of many beautiful suburban homes of New York, Newark and Paterson business men. The retail trade in 1929 amounted to \$8,464,535. Ridgewood received its charter as a village in 1894 and adopted the commission form of government in 1911. Pop. 1920, 7,580; 1930, 12,188.

RIDGWAY, a borough in northwestern Pennsylvania, the county seat of Elk Co., situated on the Clarion River, at the mouth of Elk Creek, 140 mi. northeast of Pittsburgh. Two railroads afford transportation. The vicinity has extensive natural gas wells, which supply gas to a large area. Near by are coal mines and clay pits. Ridgway has a large electrical power plant, serving many cities; also silk mills, tanneries and factories producing engines, tools, dynamos, doors, sashes, windows and snow plows. It is an important shipping point, especially for lumber. The borough is on the edge of Allegheny National Forest. Ridgway was founded in 1824; incorporated in 1880. Pop. 1920, 6,037; 1930, 6,313.

RIDLEY, NICHOLAS (c. 1500-55), English bishop, was born in Northumberland about 1500. He received his education at Cambridge, Paris and Louvain. He became chaplain to Cranmer and then to Henry VIII, and favored the Reformation. In 1547 Ridley was appointed Bishop of Rochester and, three years later, Bishop of London. When the unsuccessful attempt was made to place Lady Jane Grey on the English throne, he was implicated, and imprisoned by Queen Mary. He was condemned to death for heresy and was burned at the stake in Oxford, Oct. 16, 1555.

RIEL'S REBELLION, 1885, an uprising in the Province of Saskatchewan, Canada, of half-breeds led by Louis Riel, in protest against the land policy of the Dominion Government. After hard fighting it was put down and Riel executed for treason. *See* RED RIVER REBELLION.

RIEMANN, GEORG FRIEDRICH BERNHARD (1826-66), German mathematician, was born at Breselenz, Hanover, Sept. 17, 1826. He studied at Göttingen and Berlin and in 1851 published his thesis on the foundations of a universal theory of functions which established his mathematical fame. In 1854 his famous *On The Hypotheses which form the Foundation of Geometry* opened an entirely new conception of geometry and proved of renewed importance with the later theory of relativity. He likewise made discoveries in the theory of algebra and of functions. He died at Selasca, on Lake Maggiore. July 20, 1866.

RIEMANNIAN GEOMETRY, a branch of geometry invented by G. F. B. Riemann in 1858. This system is as follows: Let an elastic plane surface, *A*, be subjected to distensions and compressions which vary in intensity from point to point of *A*, but which leave *A* a plane. Any curve *C* of *A* will be deformed into a new curve *D*. Let the Riemannian length of *C* be defined as the actual length of *D*. There results a theory of configurations which would be called a Riemannian geometry. For instance the shortest path between two points of *A* will no longer be a straight line.

The most general Riemannian geometry is based on a more complicated transformation than that employed above. The same notion can be used in spaces of three or more dimensions. J. F. R.

RIENZI, COLA DI (c. 1313-54), Roman tribune, was born at Rome about 1313. When a youth he studied history, and his wide reading fired him with enthusiasm for the ancient glory of Rome. Toward the middle of the century, anarchy prevailed in the city, and Rienzi began laying his plans for freeing Rome from oppression. In 1347 he was acclaimed by the people and accepted the title of tribune. For a time Rienzi ruled wisely, if somewhat harshly, but soon lost favor with the people, who ridiculed his empty ceremonials and grandiloquent gestures. Forced to escape from Rome, he spent two years in a monastery, but was later imprisoned by Charles IV and Pope Clement VI. But when Innocent VI became pontiff, Rienzi was sent to Rome, 1354, to help restore order. Although successful at first, he lost his hold over the people and was killed in a tumult in Oct. 1354.

RIENZI, an opera in five acts, music and libretto based on BULWER-LYTTON's novel by RICHARD WAGNER; première, Dresden, 1840, London, 1869, New York, 1878. Composed when Wagner was but twenty-five years old, it was his first successful, though not his earliest, opera. It shows admirable mastery of the orchestra, but in mature life he took pains to disown it.

Cola Rienzi, last of the Roman tribunes, has a sister, Irene, with whom Adriano has fallen in love. Adriano is the son of Steffano Colonna, a Roman patrician. Another Roman patrician, Paolo Orsino, attempts to abduct Rienzi's sister for political reasons. Enraged by the insult offered Irene, Rienzi urges his faction to resist the outrages of the nobles. Adriano, drawn by his love for Irene, throws overboard his political affiliations and joins Rienzi. The nobles are presently defeated, and for some time are held in subjugation. But popular feeling at length turns against Rienzi who cannot stay the fickle fury of the populace, and both he and Irene, trapped in the capitol, are burned to death while Adriano, throwing down his sword, leaps into the burning building and perishes with them.

RIJETI, a cathedral city of Italy, on the Velino River, 42 mi. northeast of Rome. The cathedral dates from the 15th century. The ancient Sabine

town of Reate was built on the site. The chief occupations in the neighborhood are the cultivation of grapes, olives and corn; there is also cattle-breeding. Pop 1931, 32,152.

RIF, ER, a mountain range in northern Morocco, Africa, running along the Mediterranean coast for 180 mi. Situated between Ceuta and the western boundary of Algeria, about 2,000 ft. above sea level, it is often regarded as the outer wing of the ATLAS chain. The inhabitants are the Rif Berbers, a fierce clan given to smuggling. The wild and inaccessible regions occupied by the Rifians have made French and Spanish attempts at suppression lengthy and difficult. Their leader, Abd-el-Krim, president of the Rif Republic, surrendered to the French in 1926.

RIFFIAN WARS, THE. The laxity of the administration and the difficulties of communication in the Spanish twelfth of Morocco, encouraged some of the mountain tribes, notably the Riffs and Jebalas, to rise in rebellion or otherwise harass the authorities, particularly after 1914. For three years, from 1916-19, the famous bandit chieftain Raisuli held the Tangier-Tetuan road, and when he finally did evacuate that region, it was merely to establish a new base of operations elsewhere. Moreover, upon German instigation, he fought against the French in Morocco for some years after 1918. In 1919, however, a rival Riff leader, Abd-el-Krim, appeared on the scene.

Abd-el-Krim defeated a vastly superior Spanish army at Melilla in 1921, capturing thousands of men and 100 cannon. This and further Spanish reverses led to an overthrow of the constitutional régime in Spain and the establishment, in 1923, of a military dictatorship under General Primo de Rivera. By this time there remained under Spanish control only a narrow strip of the Moroccan coast line, and Rivera himself therefore set out to deal with the Riffs. But in 1924 he, too, met disaster and returned to Spain. In the following year Abd captured and imprisoned Raisuli and seemed in a fair way to make good his claim to the title of Sultan of Morocco.

Flushed with the thrill of success, Abd next foolishly ventured to attack the French who earlier had attempted to help the Spaniards by cutting off his grain supply. France at once despatched tanks and airplanes to Morocco, and by 1926 had a force of 150,000 men in the field. With renewed hope the Spanish now also contributed another 100,000 troops—and all this against Abd's ill-organized aggregation of less than 70,000 mountaineers. After a series of defeats, Abd was deserted by some of his followers, and on May 28, 1926 he surrendered to the French, being expeditiously shipped off to the island of Reunion, near Madagascar. The Spaniards, of course, recovered their corner of Morocco, but the French appointed a number of official advisers to help the government of Rivera put things in order.

W. C. L.

RIFLE. See GUNS.

RIFLEMAN-BIRD (*Acanthidositta chloris*), a very small wrenlike bird native to wooded ranges in

New Zealand, so called from the fancied resemblance of its handsome green and bronze plumage to the uniform of the early British volunteer rifle corps. It is only 3 in. long with a slender, slightly upturned bill and a very short tail. The rifleman-bird is exceedingly active, running rapidly up and down tree trunks in search of insects in the bark, but in flight it is feeble, using its wings chiefly to pass from tree to tree. It lays white eggs, often in nests made in holes in trees; its call is a faint, soft note. The name rifle-bird is given to a genus (*Ptilorbis*) of slender-billed birds-of-paradise, found in Australia and New Guinea.

RIFT, a vast chasm on the earth's surface, formed by the profound subsidence of long segments of the crust lying between two parallel fractures, or faults. Rivers and lakes commonly occupy these ready-made rift valleys, which are termed *structural* in distinction from ordinary erosional valleys, worn by their own streams. In such a greatly faulted region as east central Africa, blocks of the strata have dropped down thousands of feet, and the resulting Great Rift Valley holds a chain of immense lakes, of which the deepest, Nyassa, has a depth of 2,580 ft.

The most famous rift-valley is probably that of Palestine, which divides the land longitudinally, extending from Mt. Hermon to the Gulf of Abaka, and enclosing the Jordan, the Sea of Galilee, and the Dead Sea. Other notable basins due to down-faulting are Death Valley and the Coast Range valleys of California, and the Graben of the Rhine.

RIFT VALLEY, the name given in geology to the peculiar, fissure-like depression that runs the entire length of the east African highlands, first applied by the English geologist J. W. Gregory, in 1920. It appears that in the Crustacean period considerable volcanic action and general movement of the earth's crust took place in east Africa, which gradually forced up a high, arched ridge, whose crest ran from Abyssinia to south Africa. When subsequently, in Eocene times, a great sinking of land in the Indian Ocean occurred, the eastern support of this arch weakened, and the "keystone" of the arch slipped down, forming a deep, but narrow trough, following almost exactly the highest part of the ridge and causing the Rift Valley. This is most pronounced in Kenya Colony on the highlands northwest of Nairobi where a valley, more than 100 mi. long, and 50 mi. wide, runs between two steep escarpments each about 1,400 ft. high: it contains two no longer active volcanoes, Longonot and Suswa and is crossed by ridges. The depressions, thus formed, contain lakes possessing no outlets, such as Lakes Naivasha and Nakuru.

With the exception of VICTORIA NYANZA which is due to a FOLD, all the central and east African lakes appear to have been formed as part of this rift, which explains at the same time their peculiar shape—long, narrow, north-south, with steep walls. The Rift Valley may be traced southward via Lakes Magadi and Natron, through Kilimatinde and Iringi to LAKE NYASSA. Here it is joined by a more westerly division of the rift, which comprises the well known

chain of lakes Albert Edward, Kivu and TANGANYIKA. South of Nyassa the rift follows the Shire River, the Rhodesian border and quite possibly the coast line as far as Cape Corrientes or Santa Lucia Bay, the eastern wall of the rift here lying below the sea. North of the Kenya Rift Valley, the extension is via Lake Rudolph, a chain of lakes in Abyssinia, passing east of Addis Ababa, through the valley of the Hawash into the Red Sea which itself forms an integral part of it. Still further north the rift again divides into two parts, the western section of which continues through the gulf of Suez and what is now the Suez Canal into the Mediterranean, the eastern branch extending through the Gulf of Akaba, the Dead Sea and the Valley of the Jordan as far as the Taurus Mountains. See AFRICA; *Surface Features*.

RIGA, capital city and largest seaport of LATVIA, situated on the Gulf of Riga about eight miles from the mouth of the Dwina River. The city contains immense warehouses, grain elevators and up-to-date docking and shipping facilities, including floating electric cranes. The old part has narrow streets faced with tall houses and, except for the market place and a square, is devoid of open spaces. The newer quarters are lined with wide boulevards. On the left bank of the Dwina River is the suburb of Mitau, which is connected with the old city by a viaduct and bridge. Riga is an important manufacturing city, as well as one of the busiest ports of Europe. Among the manufactures are spirits, matches, shoes and boots, paints and varnishes, paper, cellulose, cotton, linen and rubber goods. The chief exports are timber, dairy produce, flax and pork. The imports include foodstuffs, clothing, machinery, tools, coal, sugar and tobacco.

The city of Riga was founded by Bremen merchants at the beginning of the 12th century. It was ruled for a time by Bishop Albert of Livonia and later became a member of the Hanseatic League. After changing hands between Sweden and Poland, it was definitely annexed by Russia in 1710, and became the chief port of the Baltic provinces of the empire. Upon the establishment of the Latvian Republic in Nov., 1918, Riga was made the capital. Pop., 1930, 377,917.

RIGEL (*Beta Orionis*), a star of the first magnitude and the brightest star of the constellation ORION. The name is derived from the Arabic *Ridjl-al-Jauza*, and means "knee of the giant." It is a very hot star, between 450 and 500 light years distant, and surpasses the sun at least 15,000 times in brightness. See STAR: *map*.

RIGGING of vessels has of recent years undergone a radical change due to the reliability of steam engines, turbines and Diesel engines for propulsion, making sails now of no use to steamers and motorships. Such rigs as brig, brigantine, bark, barkentine and even a full-rigged ship (see SHIPS, TYPES OF) are seldom seen. In Asia small sailing craft often have square sails, while on the northeast coast of Africa, there is the peculiar lateen rig, consisting of a mast

with a yard set obliquely, to the yard being fastened a large triangular shaped sail.

Cargo vessels have masts, generally two, to which cargo booms are attached, while the tops of the masts are connected by the antennae of the wireless. No sails are carried and the rigging is primarily for use in connection with the booms for handling cargo, and for signal flags. The foremast often has a crow's nest for the lookout man. Fast passenger ships have even less rigging than cargo ships, their masts are lighter and have fewer booms as little if any cargo is carried.

War vessels have only military masts, those on the larger vessels being of the tripod type, which are chiefly for observation and signal purposes.

Yachts seldom are rigged with square sails, but usually with fore and aft. In sail yachts long bowsprits with a variety of jibs and other sails have been replaced by short or no bowsprits, with fewer sails of different shape and larger area. *See also* YACHTS. C. H. HU.

BIBLIOGRAPHY—E P Morris, *Fore and Aft Rig in America*, D Steel, *Art of Rigging*.

RIGGS, KATE DOUGLAS WIGGIN. *See* WIGGIN, KATE DOUGLAS.

RIGHT ASCENSION, the angular distance, measured along the celestial equator, between a heavenly body and the vernal equinox.

RIGHTMIRE, GEORGE WASHINGTON (1868-), American educator, was born in Center Furnace, O., Nov. 15, 1868. He studied law at Ohio State University and from 1904-19 practiced patent and trademark law in Columbus. During this period he was connected at various times with Ohio State University as professor of law and acting dean. He was acting president from 1925-26, when he was elected president. Rightmire compiled and edited the second edition of *Loveland's Forms of Federal Practice*, 1920; and is the author of *Case Book-Jurisdiction and Procedure in Federal Courts*, 1917.

RIGHT OF SEARCH, the right of lawfully commissioned cruisers or other naval vessels of belligerent nations to examine and search private merchant vessels on the high seas for the enemy's property or for articles contraband of war. The United States naval vessels are directed not to allow search by foreigners and to resist force if used.

RIGHT PARTIES, the conservative or reactionary parties who, in Continental assemblies, occupy seats to the right of the president's chair. In the French Chamber of Deputies the Right includes Monarchists, the Democratic-Republican Union and the Popular Democrats; in the German Reichstag, National Socialists (Fascists) and Nationalists.

RIGHTS OF MAN, DECLARATION OF THE. Among the tasks of the National Assembly after the fall of the Bastille in the French Revolution, was the drafting of a constitution for France, in accordance with the oath which the deputies of the Third Estate representing the entire nation had taken June 20, 1789, in the famous Tennis Court. It was

generally felt by the members of the Assembly that a declaration of rights of Frenchmen as citizens should precede, or at least accompany, the proposed constitution. The object of such a statement would be to prevent for all time the repetition of abuses of a personal nature which the Third Estate had learned to associate with the absolutism in government.

Of the many drafts submitted for such a declaration, that to which the Abbé Sieyès, Mounier, and Lafayette contributed was in large part adopted. In substance, the Declaration of the Rights of Man and Citizens granted freedom of speech and press, freedom from arbitrary arrest, and trial by jury. It asserted equality before the law, but nowhere stated, contrary to common belief, that men are born and created equal, as does the American Declaration of Independence. The French Declaration likewise granted equality as regards taxation, the right to hold public office, and the right to vote. It asserted the sacredness of the right of private property, the sovereignty of the nation, the right of resistance to unlawful oppression. "No one," the document further provided, "shall be disturbed for his opinions, even on religious questions, provided that their expression shall not trouble the public peace as established by law." It may be seen, therefore, that the Declaration embodied the chief political maxims of the 18th century philosophers and represented the principal aspirations of the middle class seeking to exercise the power it had so long coveted.

Although the document was adopted by the Assembly and generally approved of, the King refused to sanction it, and the radicals criticized certain of its legal limitations on the right of free expression through pen or speech. In the constitution which followed the Declaration, further departures from the spirit of the letter was made, notably in the right to vote and to hold office. J. BA.

See B Fay, *The Revolutionary Spirit in France and America*, 1928.

RIGIDITY, MODULUS OR COEFFICIENT. *See* ELASTICITY.

RIGOLETTO, an opera in three acts by GIUSEPPE VERDI, libretto based on Victor Hugo's *Le Roi s'amuse* by Francesco Maria Piave; première, Venice, 1851, London, 1853, Paris and New York, 1857. Succeeding Verdi's first genuine success, *Ernani*, produced seven years earlier, it exceeded that success, composed though it was in forty days, and became one of the most popular of Verdi's operas. It has retained a secure place in the standard repertory of all countries.

The Duke of Mantua, a gay and unscrupulous Lothario, is assisted in his amorous adventures by his hunchback jester and pander, Rigoletto, whose constant duty and delight is mocking horrified fathers of betrayed daughters. Such a father is Count Montecrone who comes to the duke's court demanding retribution. Rigoletto laughs at the count, deriding him with sarcasm. In return, full of hate, the count calls down a curse upon the hunchback, whereupon Rigoletto, suddenly filled with superstitious fright, becomes alarmed regarding the safety of his own daughter.

ter, Gilda. He takes every precaution to guard her. Unwittingly, however, he aids another noble, Count Ceprano, who has often become the target of the hunchback's venom and who plans to abduct Gilda out of vengeance, to carry out this scheme. When he discovers the trick played on him his loyalty to the Duke of Mantua vanishes. He plans revenge on his master, hiring an assassin, Sparafucile. But his plot ironically results in the murder of his daughter. Rigolotto presently arrives at the scene and is given a sack containing, as he supposes, the Duke of Mantua. Filled with horror he gazes upon his own daughter just as he is about to cast his burden into the river.

RIIS, JACOB AUGUST (1849-1914), American social reformer and author, was born at Ribe, Denmark, May 3, 1849, and came to the United States in 1870. After working as a laborer in several trades, he became a reporter on the *New York Tribune* in 1877, and later worked on the *New York Sun*. He was active for many years in tenement-house and social reform in New York City, was instrumental in the clearing out of congested districts, and assisted in the establishment of parks and the improvement of living conditions. He was also largely responsible for the purchase of the Croton watershed as an aqueduct for New York City. He was secretary of the New York Small Parks Commission in 1897 and an executive officer of Good Government Clubs in 1896-97. His very influential book, *How the Other Half Lives*, was published in 1890. Among his other widely read books are *The Battle with the Slum* and his autobiography, *The Making of an American*. He repeatedly refused public office. He died at Barre, Mass., May 26, 1914.

RILEY, JAMES WHITCOMB (1853-1916), American poet, was born in Greenfield, Ind., Oct. 7, 1853, the son of a country lawyer. He was disinclined to study the law as his father wished and, running away from home, traveled with a patent-medicine and concert wagon, and later worked as a sign painter. He returned to Greenfield, worked for a time on the local newspaper, then began his career on the *Indianapolis Journal*. He developed his own peculiar technique while contributing to this paper his Hoosier dialect poems under the pen name of "Benjamin F. Johnson of Boone." In 1883 Riley collected these early pieces into his first published volume, *The Old Swimmin' Hole and 'Leven Other Poems*.

After this first success the poet's road was smooth, and Riley very soon became widely known and loved as "the Hoosier Poet" and "the Poet of the Common People." He made several lecture and reading tours and was elected to membership in the National Academy of Arts and Letters. His later volumes include *Afterwhiles*, 1887, *Old-Fashioned Roses*, 1888, *Pipes o' Pan at Zekesbury*, 1889, *Green Fields and Running Brooks*, 1893, *A Child-World*, 1896, *Home Folks*, 1900, *Out To Old Aunt Mary's*, 1904, *Morning*, 1907, *The Lockerbie Book*, 1911, *Good-bye Jim*, 1913, *Away*, 1913, and several volumes

of prose. A biographical edition of the poet's complete works, in six volumes, was issued in 1913 by E. H. Eitel. Riley was a genuine poet of the common people, a poet who knew at first hand the hopes, pathos and joys of their everyday lives, and who had mastered their dialect and idiom. He knew how to bring his readers either to tears or to laughter in the simplest way; occasionally he was over-sentimental. His poems for children, notably "The Raggedy Man," "Little Orphant Annie" and "Our Hired Girl," are among the best American productions of their kind. Riley died in Indianapolis, Ind., July 22, 1916.

BIBLIOGRAPHY—Marcus Dickey, *The Youth of James Whitcomb Riley*, 1919, and *The Maturity of James Whitcomb Riley*, 1922, *The Letters of James Whitcomb Riley*, ed. by W. L. Phelps, 1930.

RILKE, RAINER MARIA (1875-1926), German poet, was born at Prague, Dec. 4, 1875. After European travels and art studies at Munich, he settled in Paris as secretary to Auguste Rodin. His simple, earlier lyrics, such as *Traumgekrönt*, 1897, were followed by *Das Stundenbuch*, which overflows with Russian influence. *Neue Gedichte*, 1907, reflects his Parisian experiences. Rilke at length abandoned the impressionistic for the expressionistic style. His novel, *Malte Laurids Brigge*, is considered outstanding among contemporary prose works, and his translations of Elizabeth Barrett Browning and André Gide are noteworthy. His later writings include *Sonette an Orpheus*, 1923, and poems in French entitled *Vergers*, 1925. Rilke died at Muzot, Switzerland, Dec. 29, 1926.

RIMBAUD, JEAN ARTHUR (1854-91), French poet, was born at Charleville, Oct. 20, 1854. At an early age he began his lifelong wanderings, going in the midst of the Franco-Prussian War through perilous adventures and hardships to Paris. He was influenced by LEONTE DE LISLE, Coppée and especially by PAUL VERLAINE. His friendship with the latter ended with one of Verlaine's maniacal attacks while the two were living together in Belgium, and this disaster inspired Rimbaud with a distaste for literature. He traveled for years in Africa, where he dealt in ivory, and India; in Abyssinia he gained a fortune making cartridges for Menelik. Soon after his return to France in 1890, a tumor necessitated the amputation of a leg, ultimately causing his death at Marseilles, Nov. 10, 1891. Among Rimbaud's works are *Les Illuminations* and *Une Saison en Enfer*. His verse and prose works were collected posthumously in 1898. Perhaps no poet has been more rapturously received by his contemporaries, or exercised a more far-reaching influence.

RIME OF THE ANCIENT MARINER, THE.
See ANCIENT MARINER, THE RIME OF THE.

RIME ROYAL, a verse-form having a stanza of seven 10-syllable lines in iambic meter, arranged *ab b cc*. Developed by omitting the fifth line of OTTAVA RIMA, it was first successfully used by, and possibly invented by, CHAUCER in his *Troilus and Cressida* (14th century). Until the early part of the 17th century it was employed by many poets in preference

to HEROIC VERSE, most notably by Thomas Hoccleve, John Lydgate, James I of Scotland and by the Scottish poets, Robert Henryson and William Dunbar. It was revived for a time by WILLIAM MORRIS in the 19th century.

RIMINI, a town and episcopal see in east central Italy, situated on the Adriatic Sea, between the Aua and Marecchia rivers. The ancient Umbrian *Ariminum*, it was governed successively by Romans, Goths, Byzantines, Longobards and Franks. From 1237 to 1528 the town was ruled by the Malatesta family and its name is forever associated with a member of that family, Francesca da Rimini (see PAOLO AND FRANCESCA). The preeminent Malatesta was the impetuous and warlike Sigismondo Pandolfo (1417-68), whose passion for Isotta degli Atti is commemorated in the interlaced initials that adorn Rimini's architectural marvel, the Church of St. Francis, erected by order of Sigismondo, 1446-50. Modern Rimini is a popular bathing resort. Pop. 1931, 62,638.

RIMSKY-KORSAKOV, NIKOLAI ANDREI-VITCH (1844-1908), Russian music composer, was born at Tichvin, Mar. 18, 1844. He was sent as a youth to the naval academy but in 1873 he took up the study of music. From 1874 to 1881 he conducted the concerts of the Free Music School at St. Petersburg, and during 1886-90 led the Russian Symphony Orchestra founded by Belaiev, whose assistant he became as conductor at the Imperial Court Chapel. Earlier, in 1871, he joined the faculty of the St. Petersburg Conservatory. He was largely self-instructed but omitted no discipline which would advance his craftsmanship; eight years after producing *Sadko* he devoted an entire summer to contrapuntal tasks which he had set himself. Although his compositions are not highly polyphonic, in the common meaning of the term, the extraordinary freedom of his scores rests essentially upon his mastery of polyphony, while his general command of the orchestral palette amounts to genius of the first order. Notable for orchestral color are his pair of orchestral works, *Capriccio Espagnole* and *Scheherazade*. For all except two of his music-dramas he chose Russian national themes, combining many folk-songs of his country into the pattern of his operas. His most important operas are *Snegorotchka* and *Le Coq d'Or*, the latter being produced first in 1910, while only slightly less colorful and musically important works include *The Snow Maiden*, *The Tsar's Bride*, and the *Tale of the Invisible City of Kitezh*. In all he composed fifteen operas besides the ballet *Mlada*, three symphonies, chamber music, and many songs. He re-orchestrated MOUSSORGSKY's *Boris Godounov* and orchestrated the same composer's *Khovantchina*. With GLAZOUNOV he orchestrated BORODIN's *Prince Igor*. In addition he wrote several treatises on instrumentation and harmony, and an autobiography, *The History of my Musical Life*. He died at St. Petersburg, June 21, 1908.

BIBLIOGRAPHY.—N. A. Rimsky-Korsakov, *My Musical Life*, 1926 (Eng. trans.); and biographical article in *Grove's Dictionary of Music and Musicians*, 1927.

RINCEAU, in classic or Renaissance architecture and ornament, a branching foliated scroll in which the leaves are based principally on the acanthus leaf and the successive scrolls bear either rosettes or



ROMAN RINCEAU

bunches of leaves at their termination. The rinceau is found in Greek ornament from the 4th century B.C., but it was the Romans who first realized its almost endless decorative possibilities and made it the basis of the greater part of their carved ornament. Varied forms were also common in Byzantine, Romanesque and early Gothic architecture.

RINDERPEST, a virulent and fatal disease affecting cattle, and also attacking such wild animals as the buffalo, yak and deer. Its home is in Central Asia from whence it has spread to Europe in several great epidemics.

The causative organism has not been identified but the infection is undoubtedly spread through contact with the secretions or excretions of diseased animals. There are no special symptoms which permit of a definite diagnosis and unless the disease is known to exist in nearby localities the proper diagnosis is often not made until a postmortem has shown the characteristic functional and anatomical changes. A high fever, diarrhoea, great debility, inflammation of the mucous membranes, and sometimes a pimply skin eruption are usual symptoms, all these being aggravated in the more malignant form of the disease.

A postmortem shows marked alterations in the digestive system, including erosions on the palate, tongue and pharynx; intense congestion in the lining of the fourth stomach; and deeply ulcerated lesions in the large and small intestines and rectum. Efforts have been made to develop an immunizing serum but no great success has been attained.

RINEHART, MARY ROBERTS (1876-), American author, was born in Pittsburgh, Pa., Aug. 12, 1876, and was educated in the local public schools. Trained to be a nurse, in 1896 she was married to Dr. Stanley Marshall Rinehart of Pittsburgh. She is the author of many popular mystery stories, including *The Circular Staircase* and *The Man in Lower Ten*; of romantic novels, including *The Street of Seven Stars* and "K"; and of a humorous *Tish* series. With Avery Hopwood she wrote several plays, the most successful being *The Bat*. Her autobiographical *My Story* appeared in 1931. Mrs. Rinehart was active in the woman suffrage movement and during the World War worked with the American Red Cross in Europe.

RING AND THE BOOK, THE, a dramatic poem by ROBERT BROWNING, in 12 books totalling nearly 22,000 lines; published 1868-69. Presenting

ten different versions of the same occurrence, this extraordinary poem is a court-record of a trial for murder, but written in richly figured blank verse. Count Guido Franceschini buys the innocent child, Pompilia, from her unscrupulous parents, Pietro and Violante. He treats his bride with such cruelty that she is forced to flee from him with a young priest, Caponsacchi. Count Guido, hotly pursuing, traps Pompilia and the guiltless priest in an inn, condemning his victim to a convent and Caponsacchi to banishment. Then, having first transferred the girl to her parents' keeping, the count one night murders the innocent Pompilia, and her father and mother. He pleads skilfully, almost convincingly, but is at last condemned to death. Many consider this poem Browning's greatest work.

RING OF THE NIBELUNGEN, THE. See NIBELUNGEN, RING OF THE.

RING TENNIS, known also as deck tennis or deck quoits, a game played between two or four players, with rings and a net. The game is generally played on a court measuring 40 by 18 feet for doubles, and 40 by 12 feet for singles. A net 18 to 20 feet in length and 18 inches deep is stretched across the court, the top being 5 feet above the court. The rings are made of hemp or rubber, $1\frac{1}{4}$ inches thick, 6 inches in diameter, and weighing $6\frac{1}{2}$ ounces. Players determine the opening service by draw. The server throws the ring over the net, standing behind the base line. His opponent catches it, and must toss it from the point on the court where it was caught, to a point within the boundaries of the opposite court. Failure to catch the ring, running beyond the point where the ring is caught, or throwing the ring out of bounds, gives the opponents 1 point. Game is 15 points.

RINGWORM, an infection of the skin, nails and hair due to a parasitic fungus (*Trichophyton cerebriforme*) resembling a mould. The disease derives its name from the appearance of the lesions produced by the parasite on the scalp and on certain areas of the body. The typical eruption on the body is a circular patch, clear in the center with a sharply defined edge, made of inflamed skin with small blisters, and some scaling. The lesions may itch slightly.

Ringworm of the groin and of the feet and hands does not produce these typical patches. There may be blistering on the hands and feet. The blisters break open, leaving a raw surface. On the scalp, two types of ringworm occur. There are reddened, swollen areas, covered with whitish or grayish scales. The hair shafts in these patches are lusterless, dry and brittle, and the hairs finally fall out.

Ringworm infections are acquired by close personal contact with those infected and from clothing. Ringworm of the feet is acquired often from the floors of shower-baths or from the runway about a swimming pool. Treatment varies with the site affected. Ringworm of the nails is difficult to control. See also PARASITIC DISEASES.

W. I. F.

RIO BRANCO, JOSÉ MARIA DA SILVA PARANHOS, BARON OF (1845-1912), Brazilian

diplomat, was born in Rio de Janeiro in 1845. His father was the Viscount Rio Branco, a great statesman of the Empire. He studied law in São Paulo and Recife, traveled in Europe and then accompanied his father as secretary when the latter was sent to reorganize Paraguay after the war of 1870. He represented Matto Grosso in the Parliament from 1871 to 1876 and won popularity as the editor of the *Nação*. In 1876, as Brazilian consul in Liverpool, he carried on his studies of the history and geography of Brazil, writing many works, including a military history of Brazil. In 1884 he represented Brazil at the St. Petersburg International Exposition. After the establishment of the republic in 1889, he first organized the European immigration service to Brazil and then was sent to Washington to represent Brazil's case in the boundary dispute with Argentina, winning a notable victory in 1895. From 1895 to 1897 he prepared a memorial on the French Guiana boundaries and won this case in 1899. The Brazilian congress voted him a pension and *benemerito*. He was Minister to Berlin when, in 1902, President Rodriguez Alves appointed him to the Ministry of Foreign Affairs, where he served for three terms. The year 1903 saw his victory over Bolivia in the Acre dispute. He died in 1912 and his funeral was one of the most imposing ever held in Brazil. The finest avenue of Rio de Janeiro is named for him.

P. V. S.

RIO DE JANEIRO, a city and port of BRAZIL, the capital of the republic and the second city of South America. The city of Rio de Janeiro constitutes the Federal District, corresponding to the District of Columbia in the United States, and is politically separate from the state of the same name. The city proper covers an area of about 61 sq. mi. The chief executive of the city is the prefect, who represents the national government. He is appointed by the president of the republic, with the approval of the senate, for a term of four years.

Rio de Janeiro does not entirely depend upon the products of the region for its growth, but its wonderful harbor and its access to a vast hinterland, aside from its part as the capital of Brazil, account for its steadily growing population. Evidently, this section of the coast has been depressed in past geologic time and the ocean has backed up into a deep, broad, coastal basin, fringed with mountains of unique shape and of great beauty. Enormous sums of money have been expended upon the beautifying of this ocean front. For miles, a magnificent boulevard shaded with trees and brilliantly illuminated at night by multiple rows of ornamental lights, extends along the curving, mountain-studded shore. Unlike most cities, Rio reveals to the visitor no docks, warehouses nor anything unsightly as he enters the harbor. Even the steamer-landing is in a park-like section. The city's claim, like Sydney's in Australia, to possessing the most beautiful harbor in the world, is probably justified. Both harbors are magnificent.

Until the beginning of the present century, the streets of Rio were narrow and crooked and period-

ically the city was visited by scourges of yellow fever. Under President Alves a transformation was begun; beautiful avenues were constructed, one, the Avenida Beira Mar, stretching for over 4 mi. as a shore line boulevard, the wider parts being beautiful gardens. A vast stone quay with large warehouses was built and fine government buildings soon bordered the new avenues. Of even greater importance was the campaign against disease-carrying mosquitoes and since that time Rio has been one of the most healthful of tropical cities. The city now has a splendid opera house, said to have cost \$10,000,000, the largest library and the finest art gallery in South America and beautiful botanical gardens, parks and sea and mountain resorts. The city is located in 22° 54' S. lat. and 43° 10' W. long. There is a dry season from May to Nov. and a wet season from Nov. to May. The mean annual temperature is about 75° F., the maximum, seldom over 90°, being reached in Feb. and the minimum, 60°, in July.

Under the stimulus of high protection textile and leather manufacturing industries had been established in the city before 1914, but the World War gave Rio and Sao Paulo the opportunity to supply the domestic market more or less completely. The number of cotton spindles in Brazil increased by 1,000,000 in a few years. Flour, chemical products, furniture, cigars, sugar and perfumery are important manufactures of the city.

Public instruction is divided into primary, high school and university training and various vocational schools. The government maintains the University of Rio de Janeiro, the Collegio Dom Pedro II, a school of commerce, a trade school, a normal school for industrial teachers, national schools of music and art, military and naval academies and asylums for the blind, deaf and dumb.

The Bay of Rio de Janeiro was probably discovered by Vespucci, a Portuguese, about 1500, but its discovery is attributed by the Portuguese to Gonçalves, who visited it in 1502. Facing Rio de Janeiro at the entrance of the bay is the old settlement of the Tamoyo Indians, NICTHEROY. First sighted by de Solis in 1515, and again visited by Magellan in 1519, the Nictheroy, or "Hidden Water" as it was called by the Tamoyo natives, remained almost forgotten till the year 1531, when it was surveyed by Affonso de Souza. From its secluded character, supposed to be the mouth of some great river, the place was named Rio de Janeiro, River of January, in reference to the first day of the year, when the inlet was entered. Pop. 1920, 1,157,873; est. 1930, 1,468,621.

RIO DE LA PLATA. See PLATA, RIO DE LA.

RÍO DE ORO, a Spanish possession in northwestern Africa, stretching from Cape Nun to Cape Blanco. Known as Spanish Sahara, the area including Adrar consists of about 109,200 sq. mi., mainly desert, although containing a few oases. The southern part is technically a colony and the section to the north a protectorate. The population, about 495, is largely composed of Arabs, Berbers and Negroid people.

The entire region is governed from the Canary Islands, some of whose inhabitants first occupied the territory in 1476. Spain took possession in 1885. Fishermen from the Canary Islands and Brittany visit the coast.

RIO GRANDE, a river of southwestern United States, flowing into the Gulf of Mexico. Rising in the San Juan Mountains of southwestern Colorado, it flows eastward 80 mi. as a mountain stream, then enters the broad San Luis valley where its course changes to south. After crossing into New Mexico through the Rio Grande canyon, it continues southward across the state through a series of arid basins separated by narrow transverse ridges through which the stream has cut canyons. These basins and canyons are, from north to south, the Espanola valley, White Rock canyon, San Domingo valley, San Felipe canyon, Albuquerque valley, Isleta narrows, Belen valley, San Acacia gorge, Socorro valley, Engle valley, Elephant Butte canyon, La Palomas valley, Selden canyon, Mesilla valley, El Paso canyon and El Paso valley. From the latter point to its mouth the river forms the boundary between Texas and old Mexico and during its course through the gulf coastal plain becomes a wide, shifting stream obstructed by sandbars. Its length is about 2,000 mi. and its drainage area 248,000 sq. mi.

The Rio Grande is essentially a storm water stream subject to great and sudden floods and to extreme fluctuations in its volume. The perennial supply of water for the upper third of its course comes from the Rocky Mountains of Colorado and northern New Mexico and from its tributaries, the Conejos and Chama. The flood season for this portion is May and June and much of the water is stored for irrigation purposes. In its lower course the river is fed by the Conchos which enters from the Mexican side some 200 mi. below El Paso, and the Pecos and Devils rivers from Texas, all of which flood in Aug. and Sept. due to seasonal rains. Frequently the river is dry at El Paso when its lower course is overflowing its banks.

RIO MUNI, the mainland portion of SPANISH GUINEA on the west coast of Africa; area 9,470 sq. mi. Bata, with 8,000 inhabitants, is the capital. The Pamives are the principal tribe living in this region. Pop. 89,130, of which only 130 are whites.

RIO NEGRO, a river of South America, the great northern tributary of the Amazon. It has its sources along the watershed between the Orinoco and Amazon divide in southeastern Colombia, and also connects with the Orinoco. Its main affluent is the Uaupes. The Negro is navigable for 450 mi. from its mouth for 4 ft. of water in the dry season, but it has many sand banks and minor difficulties. In the wet season it overflows the country for long distances, sometimes to a breadth of 20 mi.; and for 400 mi. up, as far as Santa Isabela, is a succession of lagoons full of long islands and intricate channels, the slope of the current being so gentle that the river almost has none. Just before reaching the Uaupes, however, there is a

long series of reefs, over which the river flows violently in rapids, cataracts and whirlpools. The Negro, with the Uaupes, has a course of about 1,400 mi.

RIOT, a disturbance of the peace by three or more persons coming together of their own authority and intending mutually to assist each other against any who oppose them. Where persons assemble in this way and disturb the peace in the carrying on of some enterprise of a private nature, it does not matter whether the act they intend is of itself lawful or unlawful.

RIOT ACT, a law enacted in England in 1714, making it the duty of certain officers of the peace, or of any one in authority, to read before a riotous assembly consisting of as many as twelve or more persons a proclamation ordering them to disperse. To obstruct the reading of the proclamation or to continue to assemble riotously for one hour afterward is a **FELONY** and may incur a serious penalty. In English common law a riot is an indictable **MISDEMEANOR**. In the United States common law governs where no statutes have been enacted, but the majority of the states have riot acts similar to that of England although differentiated from it by differences varying in the different states. See **RIOT**.

RIO TEODORO, a river of Brazil. It rises in the province of Matto Grosso and flows in a northerly direction to empty into the Madeira, an affluent of the Amazon. It is over 900 mi. long. Formerly known as Río Duvida (River of Doubt) it was explored by Theodore Roosevelt in 1914, and was designated and mapped as Río Teodoro by the Brazilian government.

RIPARIAN RIGHTS, the rights of one owning land bordering upon a water course, or a lick or pond. At common law if a body of water is wholly upon some one's land, he has the exclusive use of it as part of his property. But where there are a number of riparian owners, use of the water is exclusively in those owners, each, however, being restricted to such uses as are consistent with like use upon the part of all other riparians. This doctrine of riparian rights obtains over the greater part of the United States. But in those parts west of the Missouri River by constitutional provision, statutes or settled customs established by judicial decision, it

has either been superseded by a doctrine of prior appropriation of water, or considerably modified by the introduction of a system of appropriation for certain purposes or with respect to certain lands.

RIPON, a picturesque town in Yorkshire, England, noted for its small but



RIPON MINSTER

interesting cathedral. This minster or cathedral, begun in 1154 and planned as a collegiate church, combines various styles of architecture. The transepts, part of the choir and portions of the nave are of the

Transitional period, 1154-81; the west front, 1215-55, is Early English; the east end of the choir is Decorated, late 13th century; and the greater portion of the nave and parts of the choir and of the central tower are Perpendicular 1458-1520. The choir has magnificent stalls, misereres and an admirable choir screen of the 15th century. The nave, which has no triforium, lacks impressiveness. The celebrated Saxon crypt, approached from the southeast angle of the nave, is attributed to St. Wilfrid in the 7th century.

The town has other interesting buildings and is the center for visits to Fountains Abbey, three miles away. Pop. 1921, 8,391; 1931, 8,576.

RIPON, a city in Fond du Lac Co., southeastern Wisconsin. It is situated 20 mi. northwest of Fond du Lac. It is served by two railroads and by bus lines. The city has knitting mills, canneries, foundries, washing machine factories and manufactures of food products. Farming and dairying are carried on in the vicinity. The city is the seat of Ripon College, coeducational, opened in 1853. Ripon was founded in 1844; incorporated in 1858. Pop. 1920, 3,929; 1930, 3,948.

RIPON COLLEGE, at Ripon, Wis., a coeducational institution, was incorporated in 1851, but not opened until 1853. It is non-sectarian and privately controlled. The productive funds in 1931 amounted to \$931,995. The library contained 27,890 volumes. In 1931-32 there were 410 students and a faculty of 37, headed by Pres. Silas Evans.

RIP VAN WINKLE, a fantastic, humorous tale by WASHINGTON IRVING, published in *THE SKETCH BOOK*, 1819. The lazy, hen-pecked Rip Van Winkle, an eccentric though well-loved citizen of a Dutch village on the Hudson, one day meets a stranger in the Catskills, and after playing at nine-pins with this new friend and a strange crew, drinks a liquor which sends him into a sound sleep. Awakening at last, he goes down the mountain and discovers, to his unbounded amazement, that he has slept 20 years. Dramatized by Dion Boucicault in 1866 and played by Joseph Jefferson, the tale was very popular on the stage.

RISK. See **INSURANCE**; **PROFITS**.

RITES CONTROVERSY, the disagreement between the Jesuits on one side and the Franciscans and Dominicans on the other, over the proper Chinese translations for certain Christian terms, and over the proper attitude toward Confucian practices, which contributed largely to the proscription of Christianity in China in the 18th century. The Jesuits had opened the way for Catholic missions in China. The Dominicans and Franciscans, coming later, appealed to the pope against the Jesuits' action in giving permission to converts to continue their adherence to certain rites of the cult of Confucius and as well as to the Chinese term which the Jesuits had chosen for God. The Jesuits had appealed to the Chinese Emperor Kang Hsi for his judgment on the meaning of certain religious terms and ceremonies. The emperor agreed with the Jesuits. The papal bulls and the utterances

of the Dominican bishops held that the emperor was inaccurate in interpreting his own language and customs. Angered by this, Kang Hsi in 1717 cancelled his earlier Edict of Tolerance and proscribed Christianity. His successors continued and enforced the proscription policy.

RITTENHOUSE, DAVID (1732-96), American mechanic and astronomical instrument maker, was born at Germantown, Pennsylvania, April 8, 1732. He was employed to survey the boundary that was afterwards known as the Mason and Dixon line, and served as professor of astronomy in the University of Pennsylvania from 1779 to 1782. From 1777 to 1789 he was treasurer of Pennsylvania and from 1792 to 1795 director of the U.S. Mint in Philadelphia. He introduced the use of cross hairs at the focus plane of transit instruments. Rittenhouse succeeded Benjamin Franklin as president of the American Philosophical Society, and most of his scientific writing appears in the publications of that organization. He died at Philadelphia June 26, 1796.

RITTENHOUSE SQUARE, a fashionable residential section in Philadelphia, Pa., located between 18th and 19th streets. It was one of the four original squares set apart by William Penn in the first city plot, but it was not developed until 1825. The four sides of the square are occupied by fine residences of some of the leading members of Philadelphia society. In the center is a small park with a bronze group by ANTOINE LOUIS BARYE, "The Lion and the Serpent."

RITUAL (Latin *ritus*), usage, particularly ceremonial and ecclesiastical. In the Christian Church it is the form of the LITURGY. Within the Latin church there are four groups of churches not adhering to the Roman rite, the Greek, Syrian, Coptic and Armenian. The word "rite" of the same origin designates specific acts or ceremonies. The *Rituale romanum* contains the rites for the administration of the sacraments, for burials, dedications, processions and other special functions, together with the prescribed formularies.

RITUALISM, or standardized ceremonies meant to influence the supernatural, is found among all primitive peoples, sometimes in elaborate form and in connection with most of the acts of daily life. Rituals range all the way from a brief recited formula to the nine-day chant of the Navajo, which must be repeated verbatim, or to the daily sacrifices with costumes, processions and priestly invocations once performed by the Aztec. It may be used only occasionally, as among the Plains Indians, or constantly, as among the Maya, who had a special ceremony for every day in the year. Ritual in some cases is practised by any one needing the help of the supernatural; in some cases it is the function of a priest, chanter or magician. Among a few peoples, like the Nootka of British Columbia, the right to perform a certain ritual is inherited and may be sold or given away.

RITUAL MURDER, called also the blood accusation, the grotesque, unfounded and thoroughly dis-

credited accusation that the Jews required and used Christian blood for the baking of their Matzoth, or unleavened bread, on the Passover festival. In the first Christian centuries the Christians themselves were accused by the Romans of eating the blood and even the flesh of non-Christians for ritual reasons on the Passover festival. Statements to this effect are found in the writings of Pliny the Younger, Tertullian, Minucius Felix and Justin Martyr. As a result of these equally absurd charges the early Christians were subjected to violent persecutions, until Christianity became the dominant and state religion, under Constantine. For hundreds of years the unjust and vicious charge remained buried. Later, however, some of the unscrupulous Christian leaders and renegade Jews turned this old anti-Christian charge against the Jews, with the result that beginning with the 12th century this false and malicious charge has continued, up to modern times, to be made against the Jews, and countless thousands of innocent Jews have been burned at the stake or killed, tortured, oppressed and exiled because of it. Yet the Bible in numerous passages (Genesis 9:4, Leviticus 7:27) forbids, under penalty of excision, even the eating of the blood of animals. The most violent ritual murder charges and consequent persecutions were those of Fulda, 1236; Munich, 1285; Prague, 1305; Ravensburg, Überlingen and Lindau, 1431; Regensburg, 1474; Trent, 1475; Tyrnau, 1494; Damascus, 1840; Tisza-Eszlar, 1882; Corfu, 1891; Polna, 1899; Konitz, 1900, and Kiev, 1911.

Hundreds of learned scholars, emperors, nobles, savants and popes, have asserted the absolute falsity and untruth of this vicious accusation. It has been demonstrated time and again that there is not the slightest hint of the use even of animal blood in all of the Bible, Talmud, rabbinical literature, and the later codes.

At present the hateful accusation is heard of occasionally, but it is certain that with the help of the enlightened Christian clergy and with the increase in education it is bound to die out entirely, and no longer be a blot on Christian civilization and culture.

A. SH.

BIBLIOGRAPHY.—*Die Papslichen Bullen Gegen die Blutbeschuldigung*, 1893; Delitzsch, *Schachmatt den Blutlügen*, 1900; Chwolson, *Der Blutaberglaube*, 1901; Graetz, *History of the Jews*, 1926

RIVADAVIS, BERNARDINO (1780-1845), Argentine statesman and soldier, born May 20, 1780 in Buenos Aires and educated at the College of San Carlos. He fought against the British invaders in 1806 and 1807, was one of the principal promoters of the emancipation movement in 1810, and in 1811 became one of the secretaries of the first Triumvirate. In 1814 he was sent on a diplomatic mission to Europe. After his return in 1820, he was appointed minister of government under Manuel Rodriguez, governor of Buenos Aires. In this capacity he introduced many liberal reforms and institutions. Among these were the bank of discount, harbor improve-

ments, the encouragement of local industries and the Lancasterian system of education. The University of Buenos Aires was founded, the monasteries limited and reformed, and bibles and the special privileges of the clergy abolished. In 1826 he was elected the first "president of the United Provinces of the River Plata." He aided Uruguay in its war of independence against Brazil, but in the face of Congressional opposition resigned his office in 1827 and retired to Europe. He died in Cadiz in 1845. His remains were repatriated in 1857.

RIVALS, THE, a brilliant comedy by RICHARD B. SHERIDAN; produced 1775. Lydia Languish is in love with the mysterious Ensign Beverley and plans a romantic elopement with him. But Lydia's aunt, the amazing Mrs. MALAPROP, arranges that the girl shall marry Captain Absolute, son of Sir Anthony Absolute. The rustic Bob Acres, a suitor of Lydia's, is urged on by the comic Irish lord, Sir Lucius O'Trigger, to fight a duel with Ensign Beverley. In the course of this duel it is discovered that Beverley is no other than Captain Absolute in disguise, and Lydia, forgoing the elopement, happily marries him. This is one of the most famous plays of the 18th century, and has been frequently produced in modern times.

RIVER, a considerable stream of water flowing through an established channel in the land. No physiographic distinction separates the world's mightiest rivers, such as the Amazon, the Nile, the Congo, and the Mississippi, from much more numerous streams of moderate or small size. Great trunk streams, together with their main branches and thousands of creeks, brooks, and rills, are known as river systems, the territory they drain as river basins.

Rivers are ordinarily features of surface drainage, and their waters ultimately reach the sea. In limestone regions, however, rivers often flow underground for miles, and in arid regions of excessive evaporation, they sometimes lose themselves in landlocked lakes, or wither away in desert sands. A typical river rises on high ground, fed by a marsh, springs, a lake, glacier, or mountain snowfield, and descends at first steeply, with torrential speed, then with diminishing gradient and velocity, to coastal plains at its mouth.

Rivers rank among the most powerful agents of erosion and transport of rock waste. Along their impetuous upper courses they sculpture mountain gorges, and dissect plateaus, using as tools the sharp sediments they carry and gravels and pebbles rolled along their beds. In their sluggish lower courses they build much of this eroded material into flood plains and deltas. It is estimated that the river systems carry to the sea every year about 5 billion tons of mineral matter in solution with some 15 billion tons of suspended sediment. Upon this river-borne load the sea depends for its saltness and for the lime needed by shell-building marine animals.

The cutting and carrying power of rivers is greatest in their steep upper course, or in time of flood, when their volume and hence their velocity, is enormously increased. Mountain torrents may reach a velocity

of 20 mi. an hour, whereas a large river traversing a plain, may not exceed a speed of a foot per second.

Rivers play an important rôle in human history. They are the primitive highways. When navigable they facilitate communication between the interior and the sea, carrying an extensive inland commerce. Their rich alluvial bottomlands and deltas support vast populations. On them depend immense irrigation and power projects and the water-supply and healthful recreation of millions of people. M. B. H.

RIVER BRETHREN, a Christian sect which originated in the middle of the 18th century among some of the Mennonite families from Canton Basle, Switzerland. They settled near the Susquehanna River, in the southwestern part of Lancaster Co., Pennsylvania, the location probably giving the sect its name, although some assert that the name is derived from their practice of baptizing in a river. Their first minister was Jacob Engle, one of the original immigrants from Basle. After many dissensions, their brotherhood in 1820 adopted the present ecclesiastical organization. They have no formal creed, but in general hold to the great evangelical beliefs, emphasizing in addition, the doctrine of non-resistance, the necessity of confession of sins to both God and man, and foot-washing as necessary in the observance of the Eucharist. Trine baptism, or immersion thrice repeated, in allusion to the Trinity is one of their fundamentals.

RIVER FOREST, a suburban city in Cook Co., northeastern Illinois, situated 9 mi. west of Chicago. It has two railroad stations on the Chicago and North Western Railroad, and is a branch of the Oak Park Post Office. Pop. 1920, 4,358; 1930, 8,829.

RIVER IMPROVEMENT, work done to aid navigation, flood control, shore protection, power development, irrigation, water supply purposes, or various combinations of these. A river may be improved for navigation by dredging or straightening CHANNELS, and removing obstructions; installing training walls and DIKES, LEVEES, REVERTMENTS; by canalization and the regulation of flow. Dredging alone in silt-bearing streams may be only of temporary benefit; in combination with proper "training works," to direct the flow and to keep channels scoured out, it is more permanent. The straightening of channels increase the ease of steering, the allowable speed, and decreases risks to shipping. Sometimes it improves "stream hydraulics." DAMS and RESERVOIRS are used to regulate flow by storing surplus flood water which may be released to increase depths at low water stages.

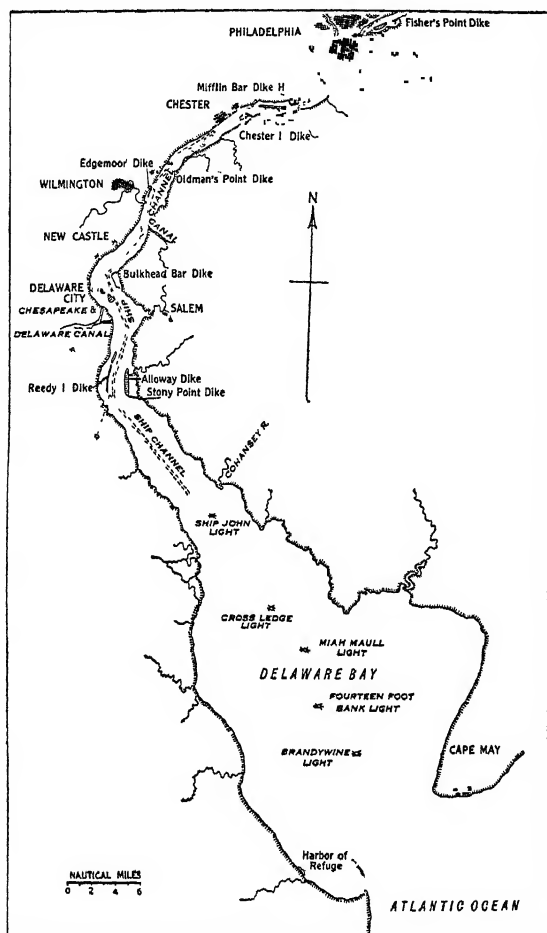
Reforestation is occasionally mentioned as a means of river regulation, but while forests affect the rate of "run-off," the effect on an important stream of any practicable reforestation would be uneconomical in comparison with other means of regulation. Flood control improvements consist of LEVEES, channel improvements, diversion and regulating works, and storage reservoirs. *See also* FLOOD CONTROL.

The works for navigation, power development and flood control may overlap, so that river improvement

projects serving more than one purpose are likely to bring about greater economics returns. F. R. H.

BIBLIOGRAPHY—J L Van Ornum, *Regulation of Rivers*, 1914

RIVER JUNCTION, a city in Gadsden Co., northwestern Florida, situated 200 mi west of Jack-



DELAWARE RIVER IMPROVEMENT BELOW PHILADELPHIA

sonville; served by four railroads. Fullers' earth deposits are the valuable resources of the vicinity. The leading local interests are agricultural. Dairying, sugar cane, tobacco and potato farming are important occupations, also pine and hardwood timber-cutting. Pop. 1930, 5,624.

RIVER ROUGE, a city of Wayne Co., southeastern Michigan, situated on the Detroit and Rouge rivers, about 6 mi. southwest of Detroit. It is served by lake steamers and four railroads. The city has a large automobile factory, a ship yard, a steel and bridge construction works, paper mills, gypsum plants and other industries. Retail trade in 1929 amounted to \$7,448,603. Pop. 1920, 9,822; 1930, 17,314.

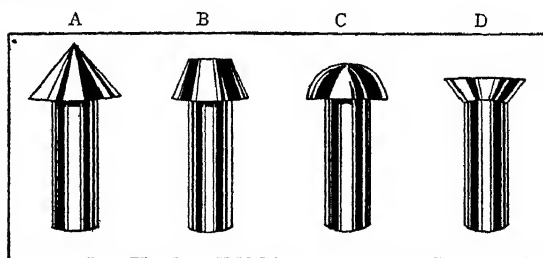
RIVERSIDE, a city in southern California, the county seat of Riverside Co., situated on the Santa Ana River at the base of the San Bernardino Mountains, 56 mi. southeast of Los Angeles. Bus and truck lines, three railroads and the Pacific Electric Line serve

the city. There are two airports. The Sunkist Trail is the principal highway. Riverside is a shipping center where thousands of cars of citrous fruit are packed annually. The handling of fruit and the manufacture of shipping machinery are the chief local industries. In 1929 the manufactured output was worth about \$5,000,000, the retail trade amounted to \$21,662,555.

Riverside is the seat of Sherman Institute for Indians, Southern California Junior College, a public junior college and the Citrus Experiment Station and School of Sub-Tropical Agriculture of the University of California. Riverside was founded on the site of a Spanish grant in 1870 and became a city in 1883. The architecture is mainly Spanish, as in the Civic Center which includes the city hall, Carnegie Library, Federal Building, Y.M.C.A., Y.W.C.A., Municipal Soldiers' Memorial Auditorium and Mission Inn. The latter, a hotel and museum, contains bells and crosses from all over the world. Palms, roses and eucalyptus line the streets. Every Easter sunrise services are held nearby on Mt. RUBIDOUX, or Roubidoux, once the scene of Indian ceremonies; on the summit is a cross in memory of Fray Junipero Serra, the founder of the California missions. The navel orange was introduced into this region from Brazil in 1873. Pop. 1920, 19,431; 1930, 29,696.

RIVERSIDE, a residential suburban city, in Cook Co., Illinois, situated 10 mi. southwest of Chicago. It is served by the Chicago, Burlington and Quincy Railroad. Pop. 1920, 2,532; 1930, 6,770.

RIVERSIDE DRIVE, a street on the west side of Manhattan Island, New York City, extending from 72nd Street to 213th Street. Riverside Drive overlooks the Hudson River and is flanked on the east side by private residences and apartment houses, and on the west side by Riverside Park which extends as far as 126th Street between the drive and the river. The New York Central Railroad runs parallel to the thoroughfare. Notable buildings and monuments of Riverside Drive are Grant's Tomb, the Soldiers' and Sailors' Monument, Riverside Church and Claremont Inn, built shortly after the American Revolution.



TYPES OF RIVETS

A, Steeple head, B, cone head, C, button head and D, counter-sunk

RIVETS, metal pins or rods headed over to prevent their moving endwise in the pieces in which they are used. They are usually made with one head shaped before putting in place, as in the figure show-

ing some of the types of rivet heads most in use. The other end is "upset" or riveted over after the rivet is in place. Small rivets are generally headed cold but larger rivets, as for boilers and in structural steel work, are heated before "heading." Heating allows a larger head to be formed without unduly disturbing the metal, and the shrinking in cooling tends to draw the parts closer together. F. H. C.

RIVIERA, a name applied to the coast line curving along the Gulf of Genoa and extending from Cannes in France to Spezia in Italy. The name is derived from the Latin *ripa*, meaning bank. The climate of this region is considered extremely healthful. Some of the world's greatest pleasure resorts and casinos are on these shores. The principal resorts are Cannes, Nice, Monte Carlo, Mentone, San Remo and Rapallo. Fruits and flowers thrive in great abundance and are exported to Paris, London and other cities.

RIVIERE DU LOUP, also known as Fraserville, a town in Temiscouata electoral district, Quebec, on the St. Lawrence River 121 miles northeast of the city of Quebec. It is served by the Canadian Northern Railroad. The principal products are furniture and paper pulp. Pop. 1921, 7,703; 1931, 8,499.

RIXDORF, since 1912 NEUKOLLN.

ROAD MACHINERY, equipment used in constructing HIGHWAYS and in maintenance and repair work. The commonest item is the "drag" which may be a split log, a short section of steel rail or a flat steel-shod frame usually drawn by horses to smooth up EARTH ROADS. The "maintainer" is an improved drag, and the "grader" has an adjustable steel cutting blade on a four wheeled chassis. Such machinery can do heavy cutting and shaping, and the cutting portion is also built into tractors as one-man "patrol" graders. For initial construction, heavy grading is done by power shovels or elevating graders. Powered with steam or gasoline engines three to 12 ton road rollers of the two-wheel tandem type, or of the three-wheel tractor type are used in construction and repair. The wheels are equipped with adjustable heavy teeth, or "scarifiers," for use in breaking up old surfaces. Separate scarifiers are dragged by tractors.

Special forms of construction equipment are used in road building, as, e.g., the "skinner scoop" steam shovel, bulldozer blade tractor, paver type concrete mixer, special forms of dump trucks, some equipped with "spreaders," for stone and gravel, and asphalt mixing plants. The finishing machine for tamping and smoothing the concrete of road slabs is a highly specialized and efficient tool which has made the quantity production of high type concrete roads possible. The pressure distributor, by which asphalts and tars can be sprayed on the road surface in precise amounts, has made it possible to obtain reliable bituminous surfaces on light types of road. W. W. H.

ROAD MAINTENANCE AND REPAIR is carried on by the particular highway administration responsible for the road or pavement. Maintenance must be continual and defects should be repaired as soon as weather conditions permit. Quick repair of

defects means economic maintenance and increases the life of the pavement, since small initial breaks in the surface often quickly enlarge under the action of traffic and weather and necessitate extensive reconstruction.

EARTH ROADS require frequent cleaning of ditches and culverts, and the "dragging" of ruts after each rain on important roads but less frequently on those lightly travelled. See ROAD MACHINERY.

For intermediate types, such as MACADAM, GRAVEL ROADS and OILED ROADS, it is important that no appreciable depressions remain in the surface which may be aggravated during a period of wet weather. For this work the power "drag" in continuous patrol service is necessary. Breaks in oiled surfaces require a general smoothing and new applications, but breaks in Bituminous surfaces of the penetration types are cared for by local patch applications of cold bitumen and mineral aggregate. Maintenance of hard surfaces, such as CONCRETE ROADS, BRICK PAVEMENTS or ASPHALT PAVING, consists mainly of sealing shrinkage cracks with a bituminous filler and occasionally replacing sections broken because of a defective local subgrade, or because of unusual expansion.

On minor rural roads some maintenance is carried out by farmers, but the better county and state roads are maintained by permanent organizations equipped with Road Machinery. W. W. H.

ROAD MATERIALS are mainly minerals found on or near the earth surface and are of two principal classes: 1. Mineral AGGREGATES to take the wear of traffic, and 2. Binders to hold the aggregate in place. Aggregates are rocks or their weathered remains. Binders are prepared products of two distinct kinds: 1. Portland Cement, and 2. either petroleum or coal tar products such as oils, oil asphalts, tars, natural asphalts or ROCK ASPHALTS. Fine sands and earths come in both classes, being the aggregate for EARTH ROADS, OILED ROADS and ASPHALT PAVING, but may act as well as binders for MACADAM and GRAVEL ROADS. Blast furnace SLAG and vitrified paving brick are natural minerals, artificially altered. Wood block sometimes used for pavement surface, and rubber blocks occasionally employed in experimental installations are the only non-mineral road materials.

Rocks are used in block form as the base of telford pavements and as GRANITE BLOCKS. Crushed rock is used in cement concrete, asphaltic concrete and in macadam roads, both with and without bituminous binders. The best stone for this purpose are the tough dark porphyritic types, often called trap rock, of the northeastern U.S. The granites are very hard, though some are brittle and easily fractured, while the more commonly used sedimentary limestones often come from quarries where excellent ledges of tough material adjoin soft, shaley deposits. Crushed stone quality is controlled by specifications and tests described under ROCK TESTS. Few SANDSTONES are sufficiently tough for road use.

Crushed stone and gravel are screened and graded to specific sizes which have been found best for each

type of construction. When mixed with sand and BITUMINOUS MATERIALS they form "asphaltic concrete" which is used for PAVEMENT BASES and PAVEMENT SURFACES. Sheet Asphalt surfaces are composed of sand, dust and bituminous materials. Sand and clay form "sand-clay" roads which are a high type EARTH ROAD; stone and screenings with or without clay binder are used for macadam roads; and gravel, sand and clay for gravel roads; while natural soil and bitumen with or without sand or stone form various types of bituminous surface treatment. W. W. H.

ROAD ROLLER. See ROAD MACHINERY.

ROAD-RUNNER (*Geococcyx californianus*), called also chaparral cock, a very curious bird of the cuckoo family inhabiting the bushy undergrowth of desert regions in the southwestern United States and adjacent Mexico. It is about 2 ft. long, with stiff brown and whitish striped plumage, a conspicuous head crest, large powerful legs and feet, and a long graduated tail which is usually held slightly elevated. The road-runner is solitary in habit and lives upon the ground, where it runs with astonishing rapidity, taking to wing only when severely pressed. It feeds upon insects, lizards, small snakes and rodents, as well as cactus fruits and sometimes young birds. Building a compact but shallow nest in mesquite trees, cactus clumps or other low growths, or sometimes using the abandoned nests of other birds, it lays usually four to nine pure white eggs. The allied but smaller Mexican road-runner (*G. affinis*) occurs from Guatemala northward to Yucatan and Vera Cruz.

ROANNE, a French textile manufacturing town, and important river port located at the uppermost navigable point of the Loire. Under Charles VII its feudal lordship was held by the merchant prince, Jacques Coeur. Roanne is famous in history for its brilliant defense against the Austrians in 1814. Pop. 1931, 40,502.

ROANOKE, an independent city in Roanoke Co., southwestern Virginia. It is situated on the Roanoke River, 175 mi. southwest of Richmond. Airplanes, bus and truck lines and two railroads serve the city. It is the headquarters of the Norfolk and Western railroad. The chief manufactures are structural steel, railroad equipment and rayon. In 1929 the total factory output was worth about \$32,500,000; the retail trade amounted to \$42,376,109. The leading interests of the countryside are dairy farming, livestock, fruit, vegetables and poultry raising. Nearby are Roanoke College for men and Hollins College for women. A village, first known as Big Lick, founded in 1874, was chartered as the City of Roanoke in 1884. Pop. 1920, 50,842; 1930, 69,206.

ROANOKE RIVER, a river of North Carolina and Virginia, rising in the Blue Ridge Mountains in southwestern Virginia. It follows a southeasterly course, receives the Dan River in Mecklenburg Co., and the combined stream continues southeastward into North Carolina. It empties into Albemarle Sound. This river is 450 mi. long and is a tidal stream for 80 mi. from its mouth. Steamboats can

ascend it 120 mi. to Weldon. At Halifax there are rapids and falls which furnish excellent water power. A canal has been built around this section. The basin of the Roanoke is principally a mining and agricultural region. The city of Roanoke is situated on its upper course.

ROBBERY, feloniously taking property by force from a person. The force need not be actually physical. Frightening one while unlawfully taking goods is also so construed. This is the common law rule and is generally followed by statutes. One aiding in a robbery, even if he gets no pecuniary returns, is equally guilty.

ROBBIA, LUCADELLA. See DELLA ROBBIA, LUCA.

ROBBING PILLARS, in mining, the removal of PILLARS of ore that have been left as temporary supports in a STOPE or ROOM. The stope is then abandoned and allowed to cave. In some methods of coal mining, coal pillars are robbed or "drawn" before the roof is allowed to cave over the mined-out portion. See also GROUND SUPPORT; BORD-AND-PILLAR; MINING, COAL; MINING, METAL; CAVING; ROOM-AND-PILLAR.

ROBERT GUISCARD (c. 1015-85), Duke of Apulia and Calabria, Norman adventurer, one of the most famous of a band of Normans who conquered southern Italy. With his brother Roger he conquered Apulia and Calabria in 1057, of which he was made Duke by the Pope Nicholas II in 1059. He next turned his attention to Sicily, from which he, with his brother Roger, proceeded to drive the Saracens. He took Messina in 1061 and Palermo in 1072, but the conquest was not completed until 1090, after his death, by Roger. Robert also captured the territory of Salerno, taking the city itself in 1076. He had meantime come into conflict with Pope Gregory VII (Hildebrand) and was excommunicated by him in 1074. In 1080, however, Gregory was reconciled with Robert in order to have him as a check against Henry IV. In 1081 Robert moved against Greece, taking Corfu and Durazzo in 1082. From his Greek conquests he was recalled by Gregory in 1083 when the latter was besieged by Henry IV in the Castle of San Angelo. Robert entered and sacked Rome (May, 1084), driving out Henry towards Salerno. Returning to the war in Greece, where his son was losing the conquered territories, Robert fell ill and died at Phiscardo in Cephalonia, July 17, 1085. He was brave, shrewd and ambitious, but without pity. His surname, Guiscard, means "crafty" or "resourceful."

ROBERTS, FREDERICK SLEIGH ROBERTS, Earl of Kandahar (1832-1914), British soldier, was born, Sept. 30, 1832, at Cawnpore, India, where his father, General Sir Abraham Roberts, was in command. He was educated at Eton, and at the military academy of Sandhurst. In 1851, he was appointed to the army service in India. Roberts was in a number of military engagements in the field, during the suppression of the Indian Mutiny of 1857-58, and in recognition of his services received the Victoria cross and promotion to captain in 1860. In 1867 he was assistant quartermaster-general in the British ex-

pedition in Abyssinia. In 1878-79, when the British were suffering reverses in Afghanistan, Roberts joined the fighting forces with the rank of major-general and in Sept., 1879, occupied Cabul, causing the abdication of Amir Yakub Khan who was replaced the next year by Abdur Rahman. The Mullahs, however, instigated a holy war against him, and he was now attacked by a great force of 100,000 Afghans. These he defeated decisively at Sherpur, Dec. 23, 1879. In the following year a British brigade was besieged at Kandahar. Roberts went to its relief by forced marches, and on Sept. 1, 1880, crushed the enemy. For this victory he was made a baronet and given the command of the Madras army.

In February 1881, Roberts was made governor of Natal, and commander-in-chief in South Africa during a short clash with the Boers. In 1882-93, he was again with the British army in India, and in 1895 he was made field marshal and given command in Ireland. When the Boer War broke out in South Africa and the British forces were hard pressed, he was given command of military operations in Dec., 1899. In the following year, he engaged in decisive operations against the Boers. The Boers being defeated, the Orange Free State and the Transvaal were annexed by England and Lord Roberts returned to London to receive high honors from the British government, being made an earl and given command of the British army. He resigned in 1905. At the outbreak of the World War Lord Roberts could not refrain from the keenest interest in the operations. He went to France in the fall of 1914, but became ill with pneumonia and died at St. Omer, Nov. 14, 1914.

ROBERTS, OWEN JOSEPHUS (1875-), American jurist, was born at Germantown, Pa., May 2, 1875. He graduated in 1895 at the University of Pennsylvania, where he subsequently served as professor of law (1901-18). Admitted to the bar in 1898, he was first assistant district attorney of Philadelphia from 1903 to 1906. During the World War he was made a special deputy Attorney-General for the purpose of prosecuting cases arising from the espionage and sedition acts in the Eastern District of Pennsylvania. In 1924 President Coolidge named him, together with Atlee Pomerene, special prosecuting attorney for the government in the famous "oil cases" involving the fraudulent leasing of certain naval oil reserves. His efforts in this connection gained him national prominence. He was appointed associate justice of the U.S. Supreme Court by President Hoover in May, 1930.

ROBERTSON, DAVID ALLEN (1880-), American educator, was born in Chicago, Ill., Oct. 17, 1880. He graduated from the University of Chicago in 1902, and was connected with that institution until 1923, becoming associate professor in English, secretary to the president, and dean of the College of Arts, Literature and Science. Robertson investigated 200 American colleges for the Association of American Universities, 1924-29. In 1930 he became president of Goucher College.

ROBERTSON, THOMAS WILLIAM (1829-71), English actor and dramatist, was born in Newark, Nottinghamshire, Jan. 9, 1829. He was eldest son of a theatrical family, and sister of Margaret Kendal. While playing in provincial companies he occasionally contributed to newspapers, and in 1860 edited a mining journal in London. Later he returned to the stage and tried his hand at farce, with little success. In 1864 his well-known *David Garrick* was produced at the Haymarket. His reputation was established by the Bancrofts' production of his *Society*, 1865. All Robertson's comedies, excepting *Garrick*, were done by them in succession: *Ours*, 1866, *Caste*, 1867, *Play*, 1868, *School*, 1869, *M. P.*, 1870. Robertson died in London, Feb. 3, 1871.

ROBERTSON, WILLIAM (1721-93), Scottish historian, was born at Borthwick, Mid-Lothian, Sept. 19, 1721. His *History of Scotland*, published in 1759, passed through many editions, and was regarded as the author's best work. It was followed by the *History of the Reign of the Emperor Charles the Fifth*, 1759, the *History of America*, 1777, and the *Disquisition concerning the Knowledge which the Ancients had of India*, 1791. His works have perhaps been unduly neglected by later generations. Robertson died near Edinburgh, June 11, 1793.

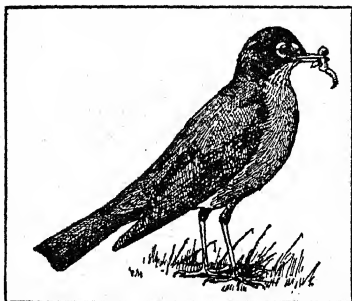
ROBERVAL, SIEUR DE (JEAN FRANCOIS DE LA ROQUE) (fl. 1535-45), French adventurer and colonizer in New France. Roberval, having been commissioned by Francis I, lieutenant general of French dominions in North America probably with the understanding that he would establish a settlement, planned an expedition to leave France in two contingents. The first, commanded by CARTIER, sailed in May 1541; Roberval was, for obscure reasons, delayed a year. His three ships sailed on Apr. 16, 1542, carrying 200 men and women colonists, and reached St. Johns, Newfoundland, June 8. Here Roberval encountered Cartier on his return to France; Cartier disobeyed orders to escort the colonists up the St. Lawrence River. The colonists, an ill-assorted company unfitted for the rigors of the wilderness, passed a miserable winter at Cape Rouge, a few miles above St. Croix. In June 1543 Roberval is said to have begun a journey up the St. Lawrence. According to one report, in 1543, Cartier was despatched to Canada to bring Roberval and the surviving colonists back to France. Conflicting accounts give Roberval dying at sea, or returning to France and dying there.

ROBESPIERRE, MAXIMILIEN FRANÇOIS MARIE ISIDORE DE (1758-94), French revolutionary leader, was born at Arras, May 6, 1758. Educated for the law in Paris, he was appointed criminal judge in Arras in 1782, but soon resigned because he was unwilling to pronounce the death sentence, and returned to the bar. In 1789 he was elected to the States-General, and he quickly became influential in the Assembly. As the advocate of democracy and of the ideas of Rousseau he argued again and again against the distinction in the new constitution between active and passive citizens, pointing out its in-

consistency with the principles proclaimed in the *Declaration of the Rights of Man and of Citizen*. Because of the self-denying ordinance Robespierre was excluded with all other members of the constituent from the Legislative Assembly. This gave him time and opportunity to gain control of the Jacobin Club and establish his popularity with the Paris populace which acclaimed him as the "Incorruptible" and in 1792 elected him as its first deputy to the Convention. In the Convention he quickly assumed a leading rôle as a member of the Mountain in opposition to the Girondists. He urged the trial and death of Louis XVI declaring "Louis must die that the country may live."

More and more as the dangers to the republic increased he advocated extreme measures. As president of the Convention and as the leading member of the powerful Committee of Public Safety he dominated the political situation, and being extremely sensitive to opposition, he brought about the downfall of one rival group after another. The execution of Danton and his friends on Apr. 6, 1794, left Robespierre virtually a dictator. As such, he tried to manipulate a series of reforms, especially measures for the moral regeneration of France, that aroused bitter resentment. The inauguration of the worship of the Supreme Being with himself as high priest aroused sarcastic criticism among all classes. Angered by the silent but strong opposition, Robespierre began to threaten but in such general terms that all parties became frightened and finally turned against him. Even the Montagnards joined with the moderates to overthrow "the Tyrant." He was arrested but escaped to the Hôtel de Ville vaguely expecting the populace to act in his favor. They re-arrested him on July 27, 1794, and he was sent to the guillotine with 18 others on the same day. W. C. L.

ROBIN, a highly esteemed American song bird (*Turdus migratorius*) of the thrush family. In regional varieties, differing only in minor characteristics, it is found almost throughout North America, breed-



G. M. SUTTON, "BIRDS OF PENNSYLVANIA,"
J. HORACE MCFARLAND CO. COPYRIGHT

AMERICAN ROBIN

ing northward to the Arctic Coast, and wintering usually far south of its nesting range, sometimes migrating through Mexico to Guatemala. The robin is about 10 in. long, grayish-slate color above, with black on the head and tail and chestnut red merging into

white below. In habit, the robin is mainly a ground feeder, frequenting all kinds of situations, and coming fearlessly about dwellings. It subsists on worms and grubs, including numerous destructive insects, and also on berries, other small fruits, and seeds. In a large nest, composed of grasses, leaves, rootlets and mud and placed usually in a fruit or shade tree, it lays 3 to 5 greenish-blue eggs, rearing generally two and sometimes three broods of young in a season. The robin, which is one of the most alert, friendly and cheerful of common birds, possesses a rich, ringing and exceedingly varied song.

The Old World robin or true robin redbreast (*Erythacus rubecola*), after which the American robin was named by the early Colonists, is a much smaller bird, about 6 in. long, with more brilliant plumage.

ROBIN GOODFELLOW, a mischievous elf or demon in English folklore. He can assume different shapes at will and is fond of performing good deeds for his friends and tricks on his enemies. Robin Goodfellow is often identified with Puck, and sometimes with the Will-o'-the-Wisp. He appears in Shakespeare's *Midsummer Night's Dream*.

ROBIN HOOD, a legendary English outlaw who is supposed to have lived late in the 12th century in Sherwood Forest, Nottinghamshire, with a merry band of followers, including Friar Tuck, Maid Marian, Little John and John Scarlet. He was fearless, daring, kind, and the idol of the poor because he robbed only the very rich. He appears in numerous poems and ballads, in several plays and operas, and in Scott's *IVANHOE*.

ROBINSON, BENJAMIN LINCOLN (1864-), American botanist, was born at Bloomington, Ill., Nov. 8, 1864. He graduated from Harvard in 1887, and received his doctorate degree from the University of Strassburg in 1889. In 1890 he became assistant at the Gray Herbarium, Cambridge, curator two years later and in 1899 was appointed Asa Gray professor of systematic botany at Harvard. Undertaking the editorship of the *Synoptical Flora of North America* in 1892, he completed sections of this work, and later (with M. L. Fernald) edited the 7th edition of *Gray's Manual of Botany*. He wrote many papers upon the classification of the higher plants of the Americas and upon the flora of the Galapagos Islands. Robinson was the editor of *Rhodora*, the journal of the New England Botany Club, from 1899-1928.

ROBINSON, EDWIN ARLINGTON (1869-), American poet, was born at Head Tide, Me., Dec. 22, 1869. He was educated at public schools in Maine and at Harvard. His first collection of verse, *The Torrent and the Night Before*, was published in 1896. A volume of *Collected Poems* received the Pulitzer Prize for Poetry in 1921, as did also *The Man Who Died Twice*, 1924, and *Tristram*, 1927. Among his other works are *The Man Against the Sky*, 1916, *Merlin, Lancelot, Cavender's House*, 1929, and *Matthias at the Door*, 1931. Robinson's poetry is marked by high imaginative quality, keen insight and eminent command of technique.

ROBINSON, FREDERICK BERTRAND (1883-), American educator, was born in Brooklyn, N.Y., Oct. 16, 1883. He graduated from the College of the City of New York, 1904, and took his Ph.D. at New York University in 1907. After teaching in the New York public schools for two years, he joined the faculty of the College of the City of New York. He was organizer and director of the division of vocational subjects and civic administration; dean of the school of business and civic administration, and became president of the college in 1927. For 20 years he was a lecturer for the New York Board of Education. His publications include *Effective Public Speaking*, 1914, and *Business Costs*, in collaboration, 1921.

ROBINSON, HENRY CRABBE (1775-1867), English diarist, was born at Bury St. Edmunds, Mar. 13, 1775. He traveled extensively, meeting Goethe, Schiller and Wieland, was connected with the London *Times*, and practiced law from 1813-28. Wordsworth, Coleridge, Lamb and Southey were his friends, his talk and breakfast parties were famous, and he helped found the Athenaeum Club and University College, London. The voluminous diaries, journals and reminiscences he left are of value for their pictures of the leading figures of the day. Selections, edited by Thomas Sadler, were published in 1869. Robinson's correspondence with the Wordsworth circle, edited by E. J. Morley, appeared in 1927. He died at London, Feb. 5, 1867.

ROBINSON, JAMES HARVEY (1863-), American historian and educator, born at Bloomington, Ill., June 29, 1863. In 1887 he was graduated at Harvard, obtaining his doctorate three years later at Freiburg. He returned to the United States to teach history, lecturing on this subject at the University of Pennsylvania, 1891, and at Columbia, 1892-1919. He resigned his professorship at Columbia in 1919 to organize the New School for Social Research, New York City. In conjunction with Professors J. H. Breasted and C. A. Beard he wrote a series of textbooks in European history which have had marked influence upon the teaching of history in secondary schools and colleges in the United States. His works include *The New History*, *The Mind in the Making* and *The Ordeal of Civilization*.

ROBINSON, LENNOX (1886-), Irish novelist and dramatist, was born at Douglas, Cork, Oct. 4, 1886. He was the author of *A Young Man from the South* and *Dark Days*. His plays include *The Cross Roads*, 1909, *Patriots*, 1912, *The Dreamers*, *The Lost Leader*, 1918, *The Whiteheaded Boy*, 1920, *The White Blackbird* and *Portrait*. Several of these plays have been produced by the Abbey Theatre, Dublin, of which Robinson was made director in 1923. He also edited *Golden Treasury of Irish Verse*, *Poems of Thomas Parnell* and *A Little Anthology of Irish Verse*.

ROBINSON, THEODORE (1852-1896), American painter, was born at Irasburg, Vt., in 1852. He studied in Paris under Carolus-Duran, Gérôme and

Monet. He painted in New York and was a foremost representative of the Impressionist School. Robinson's works include *Valley of the Seine from Giverny Heights*, in the Corcoran Art Gallery, Washington, and *Girl and Cow*, *The Old Mill* and *Bird's Eye View, Giverny, France*, Metropolitan Museum, New York. The artist died in New York City, Apr. 2, 1896.

ROBINSON CRUSOE, one of the most popular novels in English, by DANIEL DEFOE; published 1719. This eternally appealing tale, which was perhaps suggested by the strange adventures of one Alexander Selkirk, tells in a detailed and utterly convincing manner of the shipwreck and 28 years' exile of Robinson Crusoe on a desert isle usually identified with the Caribbean island of Tobago. The two most dramatic incidents of the narrative are Crusoe's discovery of the primitive savage, Friday, and, at the last, his rescue and return to England. The work was followed by two sequels, *Further Adventures of Robinson Crusoe*, 1719; and *Serious Reflections*, 1720, which purported to be the hero's diary.

ROBOT, a term applied to mechanical and electrical devices which have been constructed to operate with quasi-human intelligence; also individuals who perform a routine operation in a mechanical manner. Modern research and engineering have produced many robots to facilitate manufacturing operations. Among these may be cited work-cycle timers; mechanical, electrical and chemical testers and inspectors; fuel and temperature regulators for industrial ovens; and automatic cut-outs. Calculating machines which perform complicated mathematical calculations are a special type of robot. In a remarkably short time they solve involved equations and make complicated computations which would require days or even weeks for even an expert calculator to complete. Automatic steering devices employing gyroscopes keep airplanes and ships on their courses with greater accuracy than can be done through human skill. The applications of PHOTO-ELECTRIC CELLS form an interesting class of robots. At any change of light intensity these "electric eyes" can be made to operate relays, which, in turn, control massive and complicated machinery. Telephone principles combined with the THERMIONIC VACUUM TUBE also can make mechanical apparatus responsive to sound. Doors are operated when a person approaches them, changing the intensity of light, or when a note of a definite pitch is sounded. The word Robot was the name applied by Karel Capek to the half-human mechanism of his (1923) play, "Rossum's Universal Robots."

ROB ROY, a colorful romance of the Scotch Highlands, by SIR WALTER SCOTT; published 1817. The central character of this exciting tale is a Highland outlaw, Rob Roy Campbell, whose daring and deeds of kindness have made him known as "the Robin Hood of Scotland." The plot is concerned with the saving of Francis Osbaldistone's fortune from Francis's unscrupulous cousin, Rashleigh, and with the uniting of Francis and the romantic heroine, Diana, daughter

of Sir Frederick Vernon. There is some excellent humor supplied by Bailie Nicol Jarvie, the outlaw's distantly related cousin.

ROBUSTI, JACOPO. See TINTORETTO.

ROCA, JULIO A. (1843-1914), Argentinian general and statesman. He entered the army at the age of 15 and served in the war between the Confederation and Buenos Aires, in the war with Paraguay, and in the campaign against Entre Rios. In 1877 he was named minister of war, in which capacity he undertook a campaign against the Indians, securing for Argentina sovereignty over a wide area hitherto closed to civilization. This campaign won him wide popularity and led to his election as president in 1880, in which capacity he served until 1886. His work as president was principally toward the betterment of ways of communication and strengthening the army. He was elected for a second presidential term in 1898, serving until 1904, when he retired to private life. He emerged for a short period in 1913 to serve as ambassador extraordinary to Brazil.

ROCAFUERTE, VICENTE (1783-1847), Ecuadorian statesman. He received his education in America and Europe, and while abroad met Bolivar. In 1812 he became deputy for Guayaquil to the cortes then meeting in Cadiz and did not return to Ecuador until 1817. He abstained from revolutionary activity until 1820, when he began to write, and in the same year Bolivar sent him to Spain to negotiate with Riego. From this time until 1833 he traveled extensively and wrote, visiting Cuba, Mexico, the United States and Europe. In 1833 he returned to Ecuador and was made provisional head of the government, being elected president in 1835. His term of office was one of the most progressive periods in the history of Ecuador, initiating reform in education, finance, administration, national defense, agriculture and judiciary matters. After his Presidency, he represented Ecuador as ambassador to Peru, Bolivia and Chile.

ROCAMBOLE (*Allium Scorodoprasum*), a hardy bulbous perennial of the lily family, closely allied to the onion. It is a native of northern Europe, especially abundant in Russia. The plant is sparingly cultivated for its bulbs which are smaller in size and of milder flavor than those of the garlic.

ROCH (variously spelled Roque or Rock), saint (c. 1295-1327), was born at Montpellier, France, about 1295. His extraordinary ministrations in behalf of the plague-stricken in Rome and elsewhere in Italy gained him great acclaim and he is reputed to have worked many miracles. He died at Montpellier Aug. 16, 1327. He is invoked as the patron saint of the sick.

ROCHAMBEAU, JEAN BAPTISTE DONATIEN DE VIMEUR, Comte de (1725-1807), French marshal, was born in Vendôme, July 1, 1725. He entered the army in 1742 and fought in the War of Austrian Succession, the Seven Years' War, and in 1780 became a lieutenant general. He spent 1780-83 in America aiding the cause of independence, and upon returning to France became Governor of Picardy. He died at Thoré, May 10, 1807.

ROCHDALE, a municipal and county borough of Lancashire, England, situated upon a sharp rise above the river Roch near its junction with the Spodden, 196 mi. northwest of London. It is afforded wide water-communications by the Rochdale Canal. A Roman road passed the site, and a section of the town, Castleton, once boasted a Saxon castle. Many picturesque old buildings survive, among them the 16th century free school and the Decorated town hall. The parish Church of St. Chad, in the Perpendicular style, stands on a 12th century church site and has in its churchyard the grave of John Collier, one of the first authors to recognize the humorous possibilities of Lancashire dialect. Rochdale Manor was owned by the Byron family from 1638 until 1823 when it was sold. The town engages in the manufacture of woollens, cotton and machinery. Stone and coal are abundant in the vicinity. The consumers' cooperative movement started here.

ROCHDALE PIONEERS. The Equitable Pioneers' Cooperative Society of Rochdale, England, formed in 1844, marks the beginning of the modern consumers' cooperative movement. Twenty-eight energetic weavers, accumulating a small saving, opened a retail shop in that year, employing a novel and exceedingly workable technique. Each consumer-member was limited in his investment in the enterprise and was allowed but one vote. After paying 4% on shares and setting aside suitable reserves, all earnings were rebated to members in proportion to purchases. No credit was allowed. Ultimately it was hoped to branch out into manufacturing and agriculture and to establish a self-governing "Owenite" colony. This plan, which was copied with great success by the British cooperative movement, brought the Pioneers by 1922 to a membership of 26,000. A business of \$4,000,000 was done in that year by the one society. See also COOPERATION. C. E. W.

BIBLIOGRAPHY—G. J. Holyoake, *The History of Cooperation*; J. P. Warbasse, *Cooperative Democracy*, 1927.

ROCHEFORT, a French military port located on the Charente River about 10 mi. from the river's mouth, department of Charente-Inférieure. The military works were established by Colbert in 1666-68. In 1674 the Dutch Admiral Tromp tried in vain to capture the arsenal. PIERRE LOTI (Julian Viaud) was born here. Pop. 1931, 26,452.

ROCHELLE, FRANCE. See LA ROCHELLE.

ROCHELLE, a town in Ogle Co., northern Illinois. It is situated 26 mi. south of Rockford and is served by bus lines and three railroads. Grain and livestock are raised in the vicinity. The leading local manufactures are canned vegetables, mining machinery and woolen goods. Rochelle was founded in 1853 and incorporated in 1861. Two of the longest highways in the United States, the Lincoln and Meridian, cross in this town. Castle Rock and Blackhawk Tower are interesting landmarks of the vicinity. Pop. 1920, 3,310; 1930, 3,785.

ROCHELLE SALT, a colorless, transparent crystalline substance, having a mild saline taste, chemically

known as potassium sodium tartrate ($\text{KNaC}_4\text{H}_4\text{O}_6 \cdot 4\text{H}_2\text{O}$). It was discovered by a La Rochelle apothecary, Seignette, in 1672. It is of some value in medicine because of its purgative action. See CATHARTICS.

ROCHESTER, JOHN WILMOT, 2nd Earl of (1647-80), English poet, was born at Ditchley, Oxfordshire, Apr. 10, 1647. He graduated from Oxford when 14, traveled on the Continent, and went to the dissolute court of Charles II, where he became a favorite. But even the King was angered when the poet abducted Miss Mallett, a beautiful heiress, and Rochester was imprisoned for a time. Rochester was noted for his sharp wit and for his satirical attacks on other writers of the day, particularly JOHN DRYDEN. Among his writings are many love lyrics, the *Imitation of Horace on Lucilius* and a *Satire against Man*. Excesses early undermined the poet's constitution, and he died at Woodstock Park, July 26, 1680.

ROCHESTER, a city and municipal borough, of Kent, England, lying 33 mi. southeast of London on the Medway, and contiguous with Chatham and Strood. Originally a walled Roman-British settlement on the Roman road from Kentish ports to London, it is to-day a town of rare old buildings dominated by its castle and cathedral. The castle, built in part by Gundulph in the 11th century, has a massive keep in excellent preservation. The cathedral, also of Gundulph's planning, and continuously restored and rebuilt during the 13th and 14th centuries, stands upon the site of a church founded by Augustine. It boasts a splendid Norman west front, in the doorway-shafting of which are the two reputedly oldest statues in England, a fine crypt, and traces of early murals. DICKENS lived to the northwest of Rochester at Gad Hill, and there are many allusions to the city in his work. The commercial activities of modern Rochester include oyster growing, locomotive works and a shipping trade. Pop. 1921, 31,933; 1931, 31,196.

ROCHESTER, a city in southeastern Minnesota, the county seat of Olmsted Co., beautifully situated on the Zumbro River, 44 mi. west of Winona. Two railroads serve the city which is a trade center for live stock and dairy products. The principal manufactures are phonographs, physiotherapy bakers, pharmaceutical supplies, canned goods and cameras. In 1929 the factory output reached approximately \$3,000,000; the retail trade amounted to \$15,381,714. Just outside the city is the State Hospital for the Insane. St. Mary's Hospital, whose first consulting surgeon was W. W. Mayo, and whose sons, William J. and Charles H. Mayo are also attending physicians, is located here. The Mayo Foundation for Medical Education and Research allows graduate students to work at St. Mary's Hospital and at the Mayo Clinic. The new Mayo Clinic building, dedicated in 1928, is a skyscraper structure entirely given over to the science of healing. Rochester was settled in 1854 and incorporated in 1858. In 1883 it was visited by a tornado when 26 persons were killed. Pop. 1920, 13,722; 1930, 20,621.

ROCHESTER, a city in Strafford Co., southeastern New Hampshire, situated on the Cochecho and Salmon Falls rivers, 22 mi. northwest of Portsmouth. It is served by bus lines and the Boston and Maine Railroad. The principal manufactures are woollens, shoes, paper and wooden boxes. In 1929 the manufactures reached an approximate total of \$5,000,000; the retail trade amounted to \$4,068,447. The region produces hay, corn, grain, potatoes, vegetables and fruit. Rochester was settled in 1728 and chartered in 1891. Pop. 1920, 9,673; 1930, 10,209.

ROCHESTER, city and port of entry, county seat of Monroe Co., in northwestern New York, situated on the falls of the Genesee River, the Barge Canal, and on Lake Ontario, 70 mi. northeast of Buffalo, and 228 mi. west of Albany. It covers an area of 23,077 acres. The city is served by the New York Central, Erie, Lehigh Valley, Buffalo, Rochester and Pittsburgh and the Pennsylvania railroads, Canadian Steamship Lines, operating passenger and car ferries to Toronto and Coburg, Ont., by carriers operating on the Barge Canal, by interurban and motor bus lines and by airport. The principal part of the city is built on a plateau between 500 and 697 ft. above sea level, cut from north to south by the winding Genesee River, with bluffs 50 to 200 ft. high. The gorge of the Genesee, and its falls totalling 261 ft., are of scenic interest. The mouth of the Genesee at Charlotte forms a harbor, and the Barge Canal harbor extends from the center of the city to the main line of the canal 3 mi. south.

For the most part the streets of the city are laid out in general correspondence to the direct points of the compass. The principal business thoroughfares are Main Street and East Avenue; the latter, beyond the business district, is lined with magnificent homes. Broad Street, winding into the business section from the northwest, is a wide boulevard built over an abandoned course of the Erie Canal now used for subway, belt line and trolley tracks. The lake front, 7 miles from the heart of the city, is reached by Lake Avenue and St. Paul boulevards, two drives flanking the Genesee River, which in its course through the city is spanned by 11 bridges. The park system covers 1,777 acres.

Rochester is the market center of an important fruit and vegetable producing district. The chief industrial products are photographic equipment, scientific instruments, clothing and foundry products; in 1929 the total manufactures were valued at approximately \$380,000,000. During 1929 the retail trade amounted to \$209,392,797; the wholesale trade proper, to \$91,585,435. Government is by a city manager. Rochester is the site of the University of Rochester, containing the Eastman School of Music, the Colgate-Rochester Divinity School and St. Bernard's Seminary. The city was founded by Col. Nathaniel Rochester of Maryland in 1812. In 1834 the settlement was incorporated. Pop. 1920, 295,750; 1930, 328,132.

ROCHESTER, a borough of Allegheny Co., southwestern Pennsylvania, situated on the Ohio River, at

the mouth of the Beaver River, 25 mi. northwest of Pittsburgh. Bus lines, river craft and the Pennsylvania Railroad afford transportation. Rochester is an industrial community with large iron, steel and glass interests. The borough was founded about 1838 and incorporated in 1849. The Indian village of Sawkunk stood within the present borough. Remains of the Girard Locks of the Ohio-Lake Erie Canal are a landmark of Rochester. Pop. 1920, 6,957; 1930, 7,726.

ROCHESTER, UNIVERSITY OF, a non-sectarian institution for men and women at Rochester, N.Y., was organized in 1850, through the efforts of Rochester Baptists. The university consists of a College of Arts and Sciences, and schools of Music, Medicine and Dentistry, and Nursing. It had productive funds in 1931 amounting to \$27,364,554. The library contained 163,203 volumes. In 1930 there were 5,140 students and a faculty of 376, headed by Pres. BENJAMIN RUSH RHEES.

ROCHET (Late Latin *Rochetum*, Italian *Rochetto*, French *Rochet*, coat), an ecclesiastical vestment worn by bishops, abbots and other prelates at services other than the Mass and while present at the Mass, but not officiating as celebrant, deacon or subdeacon. It is an adaptation of the ALB, and in the Roman Catholic Church is a white linen SURPLICE with narrow sleeves and ornamented with lace. As worn by the bishops of the Anglican Church it is also a linen garment, but reaches to the ankles, and has very wide lawn sleeves gathered at the wrists with silk or satin ribbon the color and material of the CHIMERE.

ROCK, the material of which the earth is made. It is a natural aggregate of one or more MINERALS which is an essential portion of the earth's crust. Rocks occur in a wide variety of geological forms, as stratified beds, eruptive masses, intrusive bodies, chemical precipitates, pegmatite veins, and as loose soil and sand. Even water in its solid form, ice, may be considered a rock. As a rule, however, rocks are thought of as being the solid aggregates of various minerals which everywhere underlie the surface soil. They are divided into three main groups, according to their mode of origin. Those laid down by wind or water, like sandstone, are known as SEDIMENTARY ROCKS; the cooling of molten masses derived from the earth's interior produces the IGNEOUS ROCKS, such as granite. Both of these groups may be altered by heat, pressure, and circulating solutions, into the METAMORPHIC ROCKS, such as slate. See also PETROLOGY; PETROGRAPHY; GEOLOGY; GEOCHEMISTRY; EROSION; DEPOSITS; WEATHERING.

ROCK COD, the name given to numerous mail-cheeked fishes (*Sebastes* sp.; *Sebastichthys* sp.) found in the North Pacific, called also rockfish. They vary greatly in form and color, and range from about 8 in. to 3 ft. in length. So far as known they are ovoviviparous, the young, when about ¼ in. long, being brought forth in immense numbers in summer. While their flesh is rather coarse, several species are extensively used for food in California and Japan.

The catch in United States waters in 1929 was 6,678,000 lbs., valued at \$334,000.

ROCK CRYSTAL. See QUARTZ.

ROCKEFELLER, JOHN DAVISON (1839-), American capitalist, was born at Richford, N.Y., July 8, 1839. He began work in Cleveland, O., as a clerk. He was a partner in a firm of commission merchants, when they entered the oil business in 1860, and invested in an oil-refining process, invented by Samuel Andrews. This was a commercial success, and by 1870 one-fifth of all the oil-refining in Cleveland was done by this process. In that year, with the aid of his brother William Rockefeller, Stephen V. Harkness, and others, he organized the Standard Oil Co. of which he became president. Rockefeller hoped to stabilize the industry by consolidation, wherever possible, by normal promotion-methods, stable prices, and efficient machinery. The first important step was the agreement drawn in 1872 between the Standard and the South Improvement Co., an association of important refiners. By merging interests, the combine obtained preferential rates from the Pennsylvania, New York Central, and Erie railroads and received a certain portion of all freight charges paid by competitors. In the face of this competition, 21 Cleveland oil companies sold out to the Standard Oil Co. In 1875 other refineries in New York, Pittsburgh, and Philadelphia were also acquired, and by 1878 Rockefeller and his associates controlled nine-tenths of the refinery business in the nation. Oil-tanks at terminals, pipe-lines, and factories manufacturing refining machinery were purchased to extend control.

As a natural consequence of the company's growing power and profits, the legislatures of several states inquired into its methods. The New York State Senate in 1888 revealed that the Standard Oil comprised 39 subsidiary organizations, incorporated in various states, whose stocks and control were assigned to a "trust." The word became the popular symbol of the iniquity of big-business, and Rockefeller and his associates endured for many years widespread distrust. Although they as "trustees" of the 39 companies had delegated powers to themselves which were in violation of existing statutes, not until 1899 was the trust dissolved. At this time Rockefeller was known as the first billionaire. The legal difficulties of the enormous organization multiplied, and in 1907 Federal Judge K. M. Landis fined the Standard Oil Co. \$29,000,000 in the rebate trials. Rockefeller reorganized the company as the Standard Oil Co. of New Jersey, which in 1911 was declared to violate the SHERMAN ANTI-TRUST ACT, and was ordered dissolved by the U.S. Supreme Court. In that year the company distributed to its stockholders its majority stock in the subsidiary companies, and the consolidated control came to an end. The same year Rockefeller retired from active management, giving over control to his son.

Following his retirement Rockefeller turned his attention to various philanthropic enterprises which he had been developing for some years. He has con-

tributed considerably more than \$500,000,000 to colleges, and educational and public welfare organizations. See ROCKEFELLER FOUNDATION; ROCKEFELLER INSTITUTE FOR MEDICAL RESEARCH; GENERAL EDUCATION BOARD.

ROCKEFELLER, JOHN DAVISON, JR. (1874-), American capitalist, was born at Cleveland, Ohio, Jan. 29, 1874. He entered the Standard Oil Company's organization in 1897, and, on his father's retirement in 1911, became active in the work of the directorships as well as in the work of the Rockefeller Institute for Medical Research and the Rockefeller Foundation, of which last he became chairman. In 1912-13 the labor troubles in the Colorado Fuel and Iron Company aroused his interest in industrial relations. As his interest in philanthropy and sociology widened, he became less active in the operation of the Standard Oil Companies. He has aided several scientific projects, among them the Byrd expeditions to the North and South Poles in 1926 and 1928 respectively. In 1930 he became interested in developing a large section of mid-town New York to serve as a center for musical activities, and particularly for the rapidly growing radio industry.

ROCKEFELLER FOUNDATION, a philanthropic organization established by JOHN D. ROCKEFELLER and chartered in 1913 "to promote the well-being of mankind throughout the world." The original endowment consisted of \$100,000,000. The activities of the Foundation lie chiefly within the fields of the medical, natural and social sciences, the humanities and public health. It gives assistance to universities and other agencies conducting research, and co-operates with governments regarding public health. The policies and resources of the Foundation are controlled by a self-perpetuating board of trustees, who receive no salary.

ROCKEFELLER INSTITUTE FOR MEDICAL RESEARCH, a philanthropic corporation founded in 1901 by JOHN D. ROCKEFELLER "to conduct, assist and encourage investigations in the sciences and arts of hygiene, medicine and surgery, and allied subjects, in the nature and causes of disease and the methods of its prevention and treatment, and to make knowledge relating to these various subjects available for the protection of the health of the public and the improved treatment of disease and injury." The original gift amounted to \$200,000. There are three departments of the Institute, each of which is devoted to research only: the department of the laboratories, department of the hospital and the department of animal and plant pathology. The first two are located in New York City, and the third at Princeton, N.J. For the dissemination of the scientific work at the Institute and elsewhere, the following publications are maintained: *The Journal of Experimental Medicine*, *The Journal of General Physiology* and *Studies from the Rockefeller Institute for Medical Research*. Monographs are also published.

ROCKER (in engraving), called also cradle-rocker, cradle or rocking-tool, an instrument shaped like a

curry-comb, from 2 to 3 inches broad, set with sharp teeth, coarse or fine, with which to roughen the surface of a copperplate preparatory to the production of a MEZZOTINT engraving. The sharp teeth prick minute holes for the purpose of holding the ink, and the burr which is thrown up on the surface of the copper cuts into the paper under pressure and assists the absorption of the ink. The deep shadows thus produced in the print have a rich velvety effect. The whole plate is "rocked," and the roughness more or less thoroughly scraped away to produce the higher or lower degrees of light in the picture. The rocker was preceded by the ROULETTE.

ROCKET, in botany, a name originally applied to the roquette or rocket-salad (*Eruca sativa*), an annual of the mustard family. It is a native of southern Europe more or less cultivated as a spring and autumn salad plant. The name is now given to various species of *Hesperis*, a closely allied genus, of which the dame's-violet (*H. matronalis*), commonly planted in gardens, is a familiar example.

ROCKET PROPULSION, the motivation of vehicles by power developed in a series of *external* explosions. Adopting the principle employed in the pyrotechnic sky rocket (see FIREWORKS), several investigators have experimented with the use of explosion tubes for large air "rockets" and automobile propulsion. The mechanism consists essentially of a tube or tubes, in which an explosive compound, carrying its own oxygen, is deposited and burned. The energy of combustion reappears as kinetic energy in the gases issuing from the open tube and at high velocity. The reaction on the vehicle propels it in the opposite direction. The efficiency is extremely low save at a high velocity, which precludes its application for vehicle speeds of less than 700 miles per hour. It is highly doubtful if there is any chance for the commercial application of rocket propulsion although it may be employed on rockets intended to reach high altitudes.

L. H. Mo.

ROCKFORD, the third largest city of Illinois, and the county seat of Winnebago Co., situated on the Rock River, 90 mi. northwest of Chicago. Its transportation facilities include four railroad systems. Federal highways intersect at this point, and a 140-ac. municipal airport lies 6 mi. north. Rockford was the third industrial city in the State in 1929 with approximately 370 manufacturing establishments, chiefly furniture factories. In 1929 the value of the manufactures was approximately \$96,000,000; the retail trade amounted to \$56,903,830. Stock raising and dairying are suburban interests. Rockford College for Women, established in 1847, is located here. This district figured prominently in the Black Hawk War. Camp Grant, 4 mi. south, was an important military training reservation during the World War. Rockford was founded in 1834, plotted in 1836, and incorporated in 1852. Pop. 1920, 65,651; 1930, 85,864.

ROCKFORD COLLEGE, at Rockford, Ill., one of the oldest women's colleges in America, was founded as Rockford Seminary in 1847. The col-

legiate course of study was inaugurated in 1882. Nine years later the seminary course was discontinued and the name was changed to Rockford College. Among its prominent alumnae is Jane Addams of Hull House. The college is non-sectarian and privately controlled. The productive funds in 1931 amounted to \$1,043,700. The library contained 18,400 volumes. In 1931-32 there were 400 students and a faculty of 40, headed by Pres WILLIAM A. MADDOX.

ROCKHAMPTON, a seaport of Queensland, Australia, situated on the Fitzroy River, 40 mi. from its mouth. It is a well-built modern city, situated in a rich agricultural and dairying country. Besides being a port of considerable importance, Rockhampton is one of the chief railroad centers of Australia. Among industries meat-preserving takes first place. There are extensive railway repair shops, tanneries and a variety of other minor establishments. Est. pop. 1929, 30,000.

ROCK HILL, a city in York Co., northern South Carolina, situated 4 mi. from the Catawba River, 25 mi. southwest of Charlotte, N.C. The Southern Railroad, bus and truck lines and an airport serve the city. Cotton, corn and small grain are the chief crops of the district. Rock Hill is a textile manufacturing center. In 1929 the retail trade amounted to \$4,762,399. The city was founded in 1879 and incorporated in 1892. The inhabitants are predominantly Greeks. Rock Hill is the seat of Winthrop College, the state college for women. ANDREW JACKSON was born in the vicinity. Pop. 1920, 8,809; 1930, 11,322.

ROCK ISLAND, a city of northwestern Illinois and county seat of Rock Island Co., on the Mississippi River, 180 mi. southwest of Chicago. It has excellent transportation facilities, both rail and motor, including up-to-date river and rail terminals, bridge and ferry connections with Davenport, Ia., and Moline on the east, thus forming the "Tri-city" group. Two miles from the city are the mouth of the Rock River and the Hennepin Canal. The island for which the city was named is government-owned and the site of an arsenal, established 1862, where Confederate prisoners were detained during the Civil War. A Federal dam across the Mississippi River provides water-power for manufacturing a variety of products, chief of which are farming implements. In 1929 the factory output was valued at \$39,362,709; the retail trade amounted to \$18,309,133. The city is the seat of Augustana College. In 1730 villages of the Sauk and Fox Indians occupied the site of Rock Island. Ft. Armstrong, built by the United States in 1816, and abandoned in 1836, figured prominently in the BLACK HAWK WAR. Black Hawk Watch Tower, a wooded bluff near the mouth of the Rock River which the Indian leader made his rallying-point, is now a State park. Founded about 1835, Rock Island was incorporated in 1849. Pop. 1920, 35,177; 1930, 37,953.

ROCKLAND, a port city on the coast of Maine, the county seat of Knox Co., situated at the mouth of Penobscot Bay, 86 mi. northeast of Portland. It is served by the Maine Central Railroad and the Eastern

Steamship Line. There is an airport and flying school. The city is an important shipping point for fish and lobsters. Large lime-working plants, cement works, deep-sea fisheries and ship-building yards make up the chief industries. Rockland and its surroundings are popular summer resorts. The Government testing grounds for naval craft is a short distance off the coast. Rockland was founded in 1769. The lime industry was the basis of its early progress. Separating from Thomaston, it was incorporated as East Thomaston in 1848. In 1850 it was renamed, being chartered as the city of Rockland in 1854. It is the birthplace of Edna St. Vincent Millay and Maxine Elliot. Pop. 1920, 8,109, 1930, 9,075.

ROCKLAND, a town and village in Plymouth Co., eastern Massachusetts. The village is about 19 mi. southeast of Boston and is served by the New Haven Railroad. The factories of Rockland manufacture shoes, webbing and blacking. There are poultry and truck farms. Rockland was once a part of Abington but was incorporated as an independent town in 1874. Pop. 1920, 7,544; 1930, 7,524.

ROCKNE, KNUTE KENNETH (1888-1931), American football coach, was born at Voss, Norway, on Mar. 4, 1888, coming to the United States at the age of five. He entered Notre Dame University in 1910, and in his senior year became captain of the football team which, by use of passing tactics, beat the Army 35 to 13. Rockne remained at Notre Dame as an assistant coach, in 1918 becoming head coach. He developed the forward pass, back-field shift or "hop," and the art of blocking to a fine point, immeasurably raising the standard of the game. His teams were undefeated in 1919, 1920, 1924, year of the celebrated "Four Horsemen" back-field, 1929, 1930, and 1931. He died in an airplane crash near Bazaar, Kan., Mar. 31, 1931.

ROCK RIVER, a stream of Wisconsin and Illinois, rising in Fond du Lac Co. in east central Wisconsin. It flows south through Wisconsin and southwest through northern Illinois to empty into the Mississippi just below the city of Rock Island. Throughout its course of 330 mi. this river drains a broad, fertile valley. Many small tributaries flow into it and the cities of Watertown, Janesville, Beloit, Rockford, Dixon and Sterling are situated on its banks. Rock River is navigable almost its entire length but only for small steamboats owing to rapids and shoals in several places.

ROCKROSE, a numerous genus (*Helianthemum*) of herbs or subshrubs of the rockrose family (*Cistaceae*), called also sunrose. There are about 120 species, found chiefly in North and South America and the Mediterranean region. The common rockrose (*H. Chamæcistis*), a native of the Old World with white, purple or rose-colored flowers, is cultivated in numerous forms. About 10 species grow wild in North America, two of which (*H. canadense* and *H. majus*) are known as frost-weed.

ROCK-SHELL, the common name for a species (*Purpura lapillus*) of dog whelk (*Purpura*), found

in shallow water on the Atlantic coast of America north of Long Island, and on the shores of Greenland and Europe. It has a thick, deeply ridged shell, which may be white, yellow or red in color. Like other dog whelks it has a gland which secretes a purplish fluid. The animal is carnivorous, and feeds on other mollusks.

Members of a nearly related genus (*Murex*) are known as spiny rock-shells or rock whelks. Two species (*Murex trunculus* and *Murex brandaris*), that secrete a yellow fluid which turns purple in the light, were the chief sources of Tyrian purple dye, used in ancient times by the people about the Mediterranean.

ROCK SHELTERS, the name used by archaeologists to describe shallow caves used as shelters, in which implements or remains of primitive man have been found. A famous rock shelter is in the cliff called the Rock of Solutré near Macon, France. Near by were found the bones of a vast number of horses, estimated at 100,000 animals, which had been hunted for food by the dwellers in the shelter. There were also flint weapons chiefly of AURIGNACIAN type. In a rock shelter at Sorde were found skulls of the NEOLITHIC PERIOD, and a skeleton, probably of MAGDALENIAN age, described as of the Cro-Magnon type, and adorned with a girdle of lions' and bears' teeth. There is a celebrated rock shelter, called Laugerie-Basse, on the right bank of the river Vézère, France, in which remains of Magdalenian age have been found. Rock shelters are used to-day by the more primitive tribes of western Mexico, like the Tarahumare tribe. See ARCHAEOLOGY.

ROCK SPRINGS, a city in southwestern Wyoming, in Sweetwater Co., situated on Bitter Creek about 15 mi. northeast of Green River. It is a shipping point on the Union Pacific Railroad for coal and sheep, the important interests of the vicinity. Aspen Mountains are a few miles south. It was incorporated in 1888. Pop. 1920, 6,456; 1930, 8,440.

ROCK TESTS, are made to determine the suitability of rock for construction work. They include:

Abrasion Tests, are made in a *Deval* machine, which consists of a cylinder 20 centimeters in diameter and 33 centimeters in length, mounted on a horizontal shaft set at an angle of 30° with the "trunnions." The test sample weighs 5000 grams, dried. In the case of rock there are 50 pieces while in the case of gravel it is screened into four sizes and an equal amount of each size used. Six small cast iron spheres, as used in BRICK TESTING, are employed with gravel but not with rock. The cylinder is run 10,000 revolutions at a speed of 30-33 revolutions per minute. The sample is washed, dried and weighed again. The "French" coefficient of wear—for rock only—is equal to 40 divided by the per cent loss.

Toughness Test. Three cylinders 25 millimeters in diameter and in length are cut from the rock perpendicular to the bedding plane, and three parallel with the bedding plane. These are dried and tested for toughness in a "Page" impact machine. A 2 kilogram weight is dropped on the cylinder, the first blow

falling one centimeter and each succeeding blow one centimeter higher than the preceding one. The height of the blow in centimeters causing failure is the "toughness value."

Hardness Test. A dried, cylindrical core 25 millimeters in diameter and 10 centimeters or more in length is held in a grip and loaded to give a total weight of 1250 grams. It is then subjected to the wear of 1000 revolutions of a horizontally revolving iron disk or "grinding lap," on which crushed quartz is used as the abrasive agent. The *coefficient of hardness* is 20 minus one-third the loss in weight.

Crushing Strength. Two-inch cubes or two inch by four inch cylinders cut from the rock are dried and tested in compression. Values are given in pounds per square inch or in kilograms per square centimeter.

Soundness Test. The ability of a rock to withstand weathering may be studied by actually freezing and thawing samples or by the sodium sulphate test. In this test, pieces of rock are alternately cooled to 0° F. or lower and then thawed out to room temperature. In the sodium sulphate test, 10 pieces of rock are alternately soaked in a saturated sodium sulphate solution for 20 hours and then heated in an oven for four hours. At the present writing not enough information has been secured to know the exact value of this test
E. E. B.

ROCKVILLE, a city in northeastern Connecticut in Tolland Co., on the Hockanum River, 15 mi. south west of Hartford. The New Haven Railroad serves the city. Rockville is an industrial center, manufacturing chiefly silk and woolen cloth, lace and fish lines. Tobacco is the principal crop of the vicinity. The city was settled in 1726, and chartered in 1889. Pop. 1920, 7,726; 1930, 7,445.

ROCKVILLE CENTER, a village in Nassau Co. New York, a residential suburb of New York City situated on the southwestern end of Long Island, 20 mi. east of Brooklyn. The Long Island Railroad serves the village, which was founded about 1827 and incorporated in 1893. The retail business in 1920 amounted to \$15,187,144. Pop. 1920, 6,262; 1930 13,718.

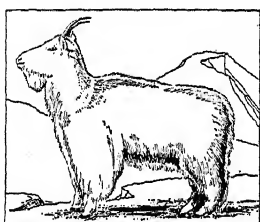
ROCK WREN (*Salpinctes obsoletus*), a species of wren inhabiting arid rocky regions in the western United States and Mexico, ranging up to an altitude of 12,000 ft. It is slightly larger than the house wren, grayish brown dotted with black and white above and dull whitish below. It seeks its food and nest among loose rocks, where it retreats whenever danger threatens.

ROCKY FORD, a town in Otero Co., southeastern Colorado. It is situated on the Arkansas River, 5 mi. southeast of Pueblo, and is served by the Santa Fé Railroad. Rocky Ford is surrounded by fertile irrigated country which produces the delicious Rocky Ford cantaloupes, also an abundance of honey-dew melons, watermelons, casabas and onions. Cantaloupes have been a commercial enterprise here since 1888. Watermelons are given away on Watermelon

Day, a festival held the first Thursday in September. Rocky Ford was settled in 1883, and incorporated in 1887. Pop. 1920, 3,746; 1930, 3,426.

ROCKY MOUNT, a city in Nash Co., in northeastern North Carolina, situated 47 mi. northeast of Raleigh, and 100 mi. south of Richmond on the "Florida Short Route." The Atlantic Coast Line Railroad, an airport and bus lines serve the city. Tobacco and cotton are the chief crops of the vicinity, and cotton, silk and lumber are the principal local manufactures. In 1929 the retail trade amounted approximately to \$13,610,000. Rocky Mount was founded in 1867 and incorporated as a city in 1907. Pop. 1920, 12,742; 1930, 21,412.

ROCKY MOUNTAIN GOAT, an American chamois (*Oreamnos americanus*), called also white goat. This goat-like white-coated mammal, standing about 40 in. tall, is related to similar species of Europe and Asia, one of which is the Alpine chamois.



ROCKY MOUNTAIN GOAT

The Rocky Mountain goat inhabits the Rocky Mountains and Coast Ranges from Montana to Alaska, descending to the higher valleys only in winter, and subsisting on the foliage of mountain plants, moss, lichens, leaves and twigs. The real home of the goat is the high peaks, where its secretiveness and agility make it of special interest to sportsmen. It is exceedingly difficult game for the hunter to pursue, as the pure whiteness of its shaggy coat conceals it from his view amid the snows and gray rocks of the summits. Its short, goat-like horns, borne by both sexes, curving slightly backward and very sharp, serve excellently against the attacks of wolves, its only enemy. From these horns the Indians of the northwest coast made the carved spoons and other implements now treasured as curiosities in our museums. They used the furry skins with their undercoat of wool as garments and ate the flesh. Though becoming rare south of the heights of British Columbia, this beautiful animal is probably safe from extermination for a long period.

E. I.

ROCKY MOUNTAIN NATIONAL PARK, in northern Colorado about 70 mi. by road or rail northwest of Denver, was established by Congress, Jan. 26, 1915. According to the revision of boundaries of June 21, 1930 the park has an area of 400.52 sq. mi.

Scenic Features. The park is situated in the heart of the Rocky Mountains. The eastern gateway is the valley village of ESTES PARK which lies at an elevation of 7,600 ft. above sea level. Its snow clad mountains, sometimes called the Snowy Range, form part of the Continental Divide which traverses the region in a general north and south direction. The majority of the summits have an altitude of more than 12,000 ft. LONG'S PEAK, the highest mountain in the park, towers 14,255 ft. above sea level. On its

eastern side, a 1,200 ft. cliff drops sheer from its summit to Chasm Lake, a body of water which is entirely or partially frozen 11 months of the year and is surrounded by perpetual snows. The lake is the cirque of an ancient glacier which helped to carve out Long's Peak and the two adjacent peaks of almost equal height, Mt. Meeker and Mt. Lady Washington.

The timberline in Rocky Mountain park occurs at about 11,000 ft. The struggle which takes place between trees and fierce icy winds, causing such sturdy trees as the ordinarily tall and mastlike Engelmann Spruce to crawl on the ground like a vine, is more easily witnessed here by the climber of average ability than anywhere else in the world. Above the timberline, the mountains rise in granite precipices, many from 1,000 to 3,000 ft. high.

Evidence of glacial action in past geologic ages is everywhere apparent, even to the most casual eye. Scarred glacial beds, now overgrown by forests, cirques and huge moraines are second in interest only to the mountains themselves as the outstanding feature of the park.

Flora and Fauna. Wild flowers are found in the most unexpected places, making the entire park a veritable garden. Gorges, meadows, mountain slopes and occasionally the loftier summits blossom from early June to late September and sometimes into October with a profusion of colors which change with the seasons. Especially notable are the blue columbines, the tall blue larkspur, monkshood in many brilliant hues, the curious little red elephant and a variety of dwarf alpine plants. Even above the timberline, brightly colored flowers are found in sheltered ravines or on the lee side of protecting snowbanks and glaciers.

The mountain sheep or bighorn, one of the most characteristic animals of the park, is sometimes seen in flocks of 50 or more. Beavers are numerous and signs of their activities can be seen along many streams in the middle altitudes. There are also numerous deer and a few elk. The wary coyotes, bears, mountain lions and bobcats are seldom seen by visitors. Fishing is excellent, the streams and lakes being stocked each year from the Colorado State fish hatchery located near Estes Park.

Travel Facilities. The Fall River Road which crosses the park from the village of Estes Park on the east to Grand Lake on the west affords one of the most impressive automobile drives in the country. At Fall River Pass, where it crosses the Continental Divide, the road reaches an altitude of 11,797 ft. above sea level. There are 200 mi. of horseback and hiking trails in the park reaching the principal lakes and gorges and some of the mountain tops.

Educational. A museum building, containing excellent habitat groups of local small mammals and birds and other instructive exhibits as well as an information office, forms the educational headquarters of the park. Educational activities include evening lectures on geology, zoology, botany, history and numerous specialized subjects, field trips and auto cara-

vans escorted by the staff naturalists and self-guiding nature trails on which the flora of the region and places of geological interest are carefully labeled.

ROCKY MOUNTAINS, the dominating mountain system of North America, running generally southeast-northwest through the western part of the continent. It is the easternmost or front range of the North American cordillera and constitutes the water parting or CONTINENTAL DIVIDE for the main river systems. Beginning at the south in New Mexico, the system is a substantially unified belt terminating in northern Alaska. It is clearly defined on the east by the GREAT PLAINS but its western boundary is less regular and not of the same character throughout.

The United States Rockies. In Colorado, Utah and Wyoming the Rockies spread to their greatest width but have less unity than elsewhere. The southernmost section centers in Colorado where the bulky Front range and high Sawatch chain cross the state in parallel formation. The former sends two northward prongs—the Laramie and Medicine Bow mountains—into Wyoming, and the Sawatch extends into New Mexico as the Sangre de Cristo range. The latter is paralleled on the west by the San Juan Mountains. The highest peaks of the entire system occur in Colorado where there are 46 summits over 14,000 ft and 300 more over 13,000 ft. Among the most prominent are Mt. Elbert, 14,420 ft., Mt. Massive, 14,404 ft., Gray's Peak, 14,274 ft., Long's Peak, 14,255 ft., and Pike's Peak, 14,110 ft.

In Wyoming there is a wide break in the crestline of the system, which provides a convenient pass to the west. Here the Great Plains extend for some distance between the southern and middle ranges. The latter group consists of the Big Horn, Shoshone, Absaroka, Wind River, Gros Ventre, Teton and Salt River ranges in northwestern Wyoming, the long Wasatch range extending from southern Idaho into Utah, and the massive east and west Uinta dome. Features of special interest in this section are the majestic Three Tetons rising to over 13,500 ft. above Jackson Hole, the Cloud Peaks in the Big Horn range, and Fremont Peak, 13,730 ft., and Gannett Peak, 13,785 ft., in the Wind River range.

Between the middle and the northern Rockies is the plateau of Yellowstone Park with a mean elevation of 8,300 ft., which affords a second transverse pass. The northern ranges consist of a belt of separate parallel uplifts in western Montana including the Bitterroot chain on the Idaho-Montana boundary, and a labyrinth of ridges and peaks in central and northern Idaho. This section has no peaks over 13,000 ft. Its most notable feature is the region of Glacier National Park in the Lewis and Clark ranges which lie on the Canada-Montana boundary. The western limits of the United States Rockies are the Colorado plateaus, the Great Basin and the Columbia plateau.

Canadian Rockies. This section forms the boundary between Alberta and British Columbia for 450 mi. and has a continuous axis north for 1,000 mi. It is defined on the west by the Rocky Mountain trench, a

long, narrow depression occupied by the headwaters of the Kootenai, Columbia, Canoe, Fraser, Parsnip, Finlay and Kachik rivers and extending to the Liard River. Although none of the Canadian peaks exceed 13,000 ft., the highest masses are alpine in character and support great ice fields. The highest peaks include Mt. Robson, 12,972 ft., Mt. Columbia, 12,294 ft., and Mount Assiniboine, 11,870 ft. The most frequently used passes are Kicking Horse, 5,329 ft., crossed by the Canadian Pacific, Vermillion, 5,376 ft., crossed by a motor road, and Yellowhead, 3,711 ft., crossed by the Canadian National. Some of the grandest scenery of the continent is found in Jasper National Park in Alberta near the Yellowhead Pass. Of the Rockies north of the Liard River little is known except that the ranges are lower and less continuous than those to the south. They include the Mackenzie Mountains and follow the height of land between the Peel and Yukon river systems to the Arctic coast.

Alaskan Rockies. At the Canada-Alaska boundary the Rockies turn westward and run nearly parallel with and about 200 mi. inland from the Arctic shore. Here they are known as the Endicott range. They decrease in elevation from about 8,000 ft. near the Canadian frontier to 1,000 ft. at Kotzebue Sound.

ROCKY MOUNTAIN SPOTTED FEVER, a febrile, non-contagious disease of man confined to the mountainous area in the northwestern quarter of the United States. The cause of the disease is an intracellular rickettsia body which is transmitted through the bite of the tick. The causative organism grows primarily in small rodents, as ground squirrels. The larval and nymphoid stages of the tick are passed on to these animals, where they become infected with the organism of the fever. The adult form, developed the next spring, feeds on large animals, as sheep, and frequently becomes attached to man.

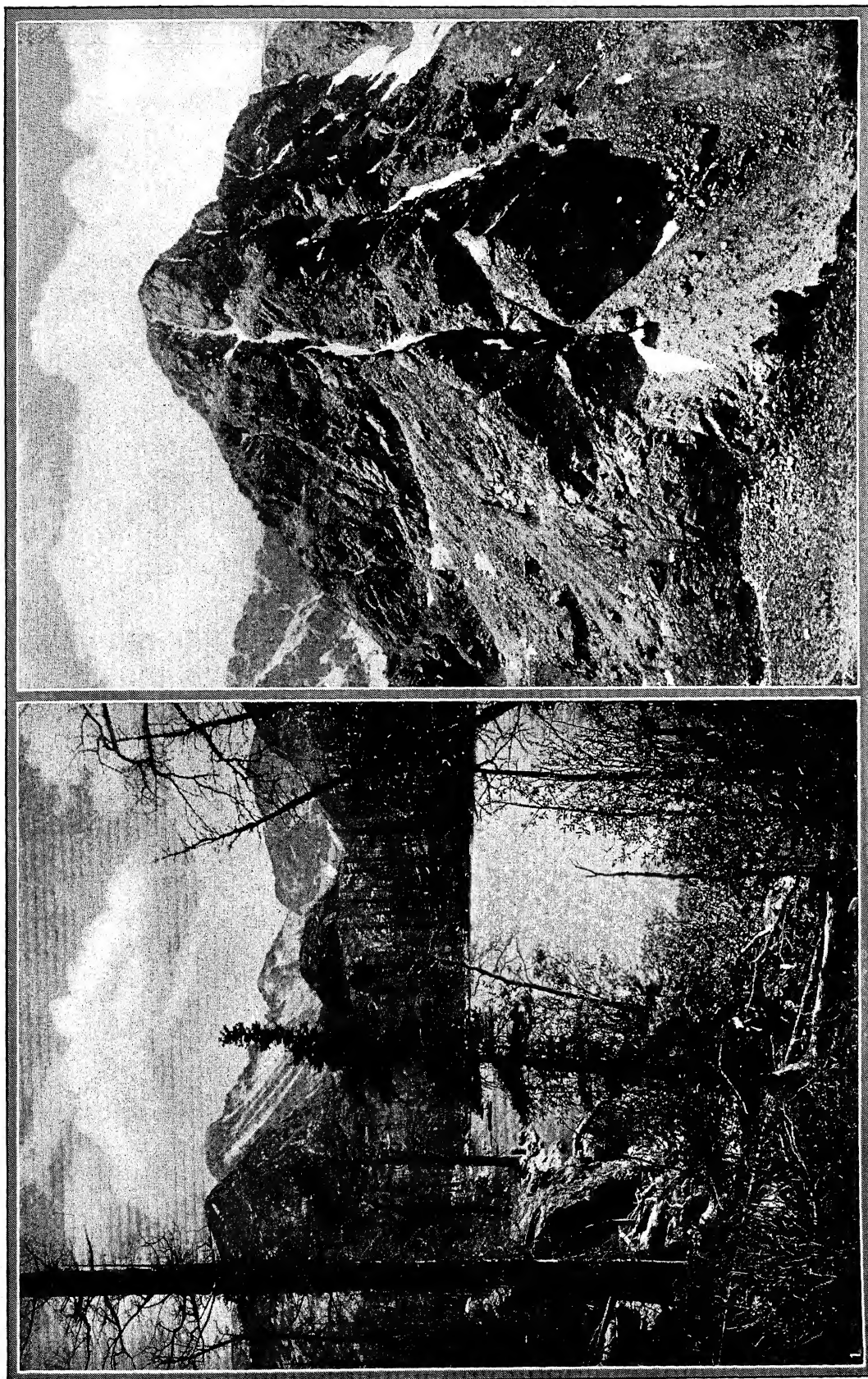
Within from four to seven days after infection, the patient becomes listless and vaguely ill. This is followed by a chill and a high fever which gradually lowers after about a week. A rash develops on the body late in the course of the disease. The heart becomes rapid, and by its failure frequently induces a fatal termination.

No specific or useful remedy has been found. Rest and careful nursing are the most important points in its treatment. Eradication of the causative organism seems impossible, in view of the inaccessibility of the rodent population. Vaccination has been tried but is of doubtful value. A single attack of the disease protects against further infection. An Eastern form transmitted by the dog tick has been recorded. *See also* TROPICAL MEDICINE.

W. J. S. K.

ROCOCO STYLE, in architecture and decoration, the term applied to the extreme of fancifulness, ornamentation and lavish use of curved lines which grew out of the Baroque revolt (*see* BAROQUE STYLE). Rococo left the Classic style behind, while keeping the general horizontal or rounded effects and remaining, as was the Baroque, definitely non-Gothic. The style

ROCKY MOUNTAINS



THE GRANDEUR OF COLORADO MOUNTAINS

1. Long Peak, viewed from Bear Lake, Estes Park.
2. Mount of the Holy Cross. The snow-filled crevices near the peak form the lines of a cross.

COURTESY THE COLORADO ASSN.

developed in France in the early years of the reign of Louis XV (the Regency). Its name came from the French word *rocaille*, rock work, as used in artificial grottoes. The lines of a shell, with its twists and curves, are typical of rococo work; scrolls and garlands were very popular in this period. In rococo the ornamentation itself outranks the structure in importance, and the style lends itself best to interiors and to decorative detail. Not unnaturally, it finds its most charming expression in the style of furniture and decoration known as Louis Quinze. Artificial, ungoverned, but at its best gay, graceful and delicate, the style held popularity until classic forms won favor again in the later 18th century. For bibliography see RENAISSANCE ARCHITECTURE.

RODENTIA, the scientific name for an order of placental mammals commonly called rodents. They have a pair of chisel-like teeth, which continue to grow throughout their lives, in each jaw. These teeth are specialized for gnawing.

Most rodents are rather small creatures. The largest is the capybara of South America, whose body is sometimes 4 ft. long. There are a tremendous number of species, more, perhaps, than of all other mammals. They owe their success in survival not to physical strength, but to their usually retired lives, vegetarian habits and unusual fecundity. The majority are terrestrial; some, like the prairie dogs, dig homes underground; the blind moles resemble true moles, and live subterranean lives; some, as the beavers, are largely aquatic, while the flying squirrels are not only arboreal but are provided with volplanes for sailing through the air. See also BEAVER; CHINCHILLA; HARE; MOUSE; RABBIT; RAT; SQUIRREL; WOODCHUCK.

RODENTS; Plague in. See PLAGUE.

RODERICK RANDOM, the first novel of TOBIAS SMOLLETT; published 1748. It is a boisterous satirical tale of life on the high seas. Roderick Random, a mischievous, rather coarse-grained young Scot, runs away from the chemist to whom he has been apprenticed and becomes a surgeon's assistant on a man-o'-war. After numerous exciting adventures, the greatest of which befall during the expedition to Cartagena, 1741, the hero discovers his long-lost father, and, marrying the beautiful Narcissa, retires to Scotland. Important characters are Lieut. Bowling, Mack-shane, the surgeon, the brutal Capt. Oakum, and the hero's loyal friend, Hugh Strap.

RODIN, AUGUSTE (1840-1917), French sculptor who achieved the most individualistic style and acquired the widest fame of any sculptor of his generation, was born in Paris in 1840. His fame was probably due as much to the uniqueness of his style as to any other factor, though there were other causes that entered into his claim upon the public attention. Among these may be cited his perhaps unconscious but very strong sympathy with the democratic tendencies of modern feeling and his insistent and successful effort to embody the French ideal. His great symbolic figures, such as *The Thinker* and *The Citizens of Calais* were charged with intense feeling.

Modern laboring men posed for them with the result that the aristocratic and intellectual aloofness of Michelangelo's symbols were replaced by a quality more directly addressed to the great general public and more easily understood by the masses. In his monument to Balzac he reached the summit of eloquence in expressing the national pride in the famous novelist. The chief characteristics of Rodin's style lay in his impressionism, which led him to abandon the surface smoothnesses practiced by Canova for a swifter and less hampered treatment in which the touch of the thumb and the roughness of the clay were continued into the permanent bronze. In his use of stone he was again original and often left great masses of rough-hewn rock to form a contrast to the more finished portions of the work. A notable success in this line is called *La Pensée*, and in it, the sensitiveness of the head is peculiarly emphasized by the rough block of stone from which it so strikingly emerges.

Like many modern artists Rodin was combatted at every step of his career. The male figure, *The Bronze Age*, one of his now acknowledged masterpieces, was refused when first offered to the Salon on the plea that it was not a work of art but a mere cast from a living model. The *Citizens of Calais* was at first refused, and considerable pressure had to be brought to bear upon the present citizens of Calais before they accepted it. The statue to Victor Hugo raised a clamor, and later on, and in spite of the world-fame that had descended upon the sculptor, a still greater outcry was raised against the monument to Balzac. This was rejected by the Société des Gens des Lettres which had commanded it, and the whole world of art took furious issue on the question. Rodin withdrew his claim, and for some years the figure was shrouded from public gaze in the artist's garden at Meudon. Now at last its great merit slowly begins to be recognized. In general it may be said that the permanent success of Rodin's work has been almost in exact ratio to the fury of the criticism leveled against it upon first appearance. His Balzac, for instance, will no doubt rank in the future among his major performances. More than any other work it publishes the lyrical, ecstatic feeling to which Rodin aspired. It has the looseness and freedom that can be seen in the artist's series of admired watercolor drawings, drawings that ought to be mentioned in any account of the artist's achievement. It is Balzac seen in a dream, a work of singular imaginative force. Though it still shocks the newcomer by the daring with which the physical aspects of Balzac have been handled, it wins the most conservative students in the end.

A branch of sculpture in which Rodin was never seriously challenged was portraiture. A number of his portraits were acclaimed at once as masterpieces, such as the J. P. Laurens, Legros, Dalou, Antonin, Proust and Mme. Vicunha. The sculptor lived to see his work generally accepted and received all the honors a finally grateful nation could bestow. He was made Commander of the Legion d'Honneur in 1903 and a Grand Officer in 1910 on his 70th birthday. The

Hotel Biron, an 18th century building in Paris, used by Rodin as a studio, is now a state museum devoted to his works which can be studied there to advantage. Rodin died Nov. 17, 1917. H. McB.

RODNEY, GEORGE BRYDGES RODNEY, Baron (1719-92), English admiral, was born at Walton-on-Thames Feb. 19, 1719. Educated at Harrow, he entered the navy 1732, was commissioned a lieutenant 1739, and as commander of the Eagle, took part in the victory off Ushant 1747. Two years later he received his appointment as Governor and Commander-in-Chief of Newfoundland. He aided in the capture of Louisbourg 1758, and confiscated an immense amount of merchandise after his successful attack of St. Eustatius, a Dutch possession in 1781. His most important battle was off Dominica where he defeated the French, 1782. For this he was created Baron Rodney of Rodney Stoke, and voted a pension. He went into retirement and died at London, May 1792.

RODÓ, JOSÉ ENRIQUE (1872-1917), South American author, was born at Montevideo, Uruguay, July 15, 1872. Called "the South American Emerson," he is regarded by many Spaniards and Spanish-Americans alike as the foremost essayist and one of the greatest Castilian stylists of his generation. His writings, the fruit of a quiet, dedicative life, have had an immense influence upon the youth of his continent. They have even come to symbolize one of the two main attitudes of Spanish America toward itself and the rest of the world. It is Rodó who defined once for all the concepts of Ariel and Caliban as applying, respectively, to the civilization of his continent and of North America. Ariel thus stands for the lofty, spiritual values, while Caliban represents blind, rampant materialism. It is an obvious objection that such a view is too schematized, that a salutary blend of these qualities would prove more vitalizing than a fanatic dedication to either. Rodó saw this; what is more, his philosophy has met with growing opposition in his own continent, where it is regarded as a poetry of life at the expense of the sanative prose. He remains, nevertheless, a figure of profound and enduring influence, whose pages are replete with beauty of expression that may be enlisted in the service of the beauty of life.

In the very year of Rodó's birth was formed the University Club, later called the Atheneum, which stood for the spirit of free investigation uncramped by clericalism. Rodó was educated in the first lay school established in the country; from his mother he imbibed an undogmatic, non-clerical Catholicism. Early giving up his visits to the Church, he proved to be of a studious nature, and at the age of 21 was accounted a prodigy. In 1901 he gave up teaching and soon acquired note as a writer. Rodó did not leave his country until the end of his life. He died at Palermo, Sicily, May 1, 1917, during a trip to Europe undertaken for *Caras y Caretas*, the well-known magazine of Buenos Aires.

Rodó's best known works are *Ariel*, *Motivos de Proteo*, both of which have been translated into English, and *El Mundo de Próspero*. Much of the work that is reproduced in this admirable collection was written originally for the *Revista Nacional de Literatura y Ciencias Sociales*, which Rodó founded in collaboration with Victor Perez Petit, the novelist, and the brothers Martinez Vigil. In *Ariel*, which has been called the intellectual breviary of Spanish-American youth, he develops the placid idealism of which mention has already been made. The *Motives of Proteus*, his central achievement, is the dynamic expression of his philosophy. As Ariel is eternal youth, Proteus is eternal change guided by the essential unity of a dominant personality. The *leit-motif* of the book becomes "Reformarse es Vivir"—self renewal is life. In the panorama of Spanish-American literature Rodó is the Apollonian spirit that serves as complement to the Dionysian spirit of Ruben Darío. I. G.

BIBLIOGRAPHY—Rodó y sus Críticos, ed by H D Barba-gelata, 1920, I. Goldberg, *Studies in Spanish-American Literature*, 1920.

RODRIGUEZ DAM, located on the Tia Juana River, Lower California, Mex., is the second highest hollow dam in the world, being of the reinforced concrete, flat deck type known as the "Ambursen" type dam. This structure is 187 feet high above the river bed and 240 feet above lowest foundation level. The presence of a fault in the foundation rock in the bed of the river was overcome by supporting the four highest buttresses on a concrete arch which spans the fault and carries its load to the firm rock on the sides of the fault. In addition, a cutoff wall was built downward through the fault. The supporting buttresses for the reinforced concrete deck are spaced every 22 feet, have a maximum width of 225 feet and maximum thickness of 9.5 feet. The dam contains 190,000 cubic yards of concrete, has a top length of 2200 feet and creates an irrigation storage reservoir of five billion cubic feet capacity. It is of the non-overflow type, the spillway being a separate structure.

ROE, EDWARD PAYSON (1838-88), American clergyman and novelist, was born at New Windsor, Orange Co., N.Y., Mar. 7, 1838. He studied at Williams College and at the Auburn and Union seminaries. He was pastor of the Presbyterian Church at Highland Falls, N.Y., until 1874, when he retired in order to lecture, write and grow fruit. His first novel, *Barriers Burned Away*, 1872, was about the Chicago fire. This was followed by *What Can She Do*, 1873, *From Jest to Earnest*, 1874, and *Without a Home*, 1880. Roe died at Cornwall, N.Y., July 19, 1888.

ROEBLING, JOHN AUGUSTUS (1806-69), American engineer and bridge-builder, was born at Mühlhausen, Prussia, June 12, 1806. He came to the United States after his graduation at the Royal Polytechnic School, Berlin, and settled at Pittsburgh, Pa. He spent several years in iron and steel manufacture, and in 1844 built the first suspension bridge over the Allegheny River. In 1851 Roebling undertook to construct a suspension bridge across the Niagara River.

After the completion of his bridge over the Ohio River at Cincinnati, O., he was appointed chief engineer in 1868 of the proposed Brooklyn Bridge, over the East River between Manhattan and Brooklyn. He was injured in the course of its construction, and died at Brooklyn, N.Y., July 22, 1869.

ROEBUCK, JOHN ARTHUR (1801-79), British statesman, was born at Madras, India, Dec. 28, 1801. Brought up in Canada, he went to England in 1824, studied law and was member of Parliament from 1832 until his death. In 1855 his charges of inefficiency in the management of the CRIMEAN WAR defeated Lord Aberdeen's Cabinet and a commission was appointed to inquire into the charges. He died Nov. 30, 1879, at London.

ROEBUCK, the male of the roe deer (*Capreolus capreolus*) of Europe and northern Asia. It is the smallest of European deer, standing about 20 in. high at the shoulder; dark reddish brown in color, becoming gray in winter, rump white. The fawns are spotted with white during their first season. The buck's antlers are short, rough, and much branched. The roe's favorite resorts are woods with thickets, in which family parties move about in regular paths. It is an agile jumper, swims well, and is a favorite object of sports, although its flesh is inferior as venison; it has become scarce in Great Britain, except in the Scottish Highlands. See also DEER.

ROENTGEN, WILHELM KONRAD VON (1845-1923), German physicist, was born at Lennep, Mar. 27, 1845. He received his doctor's degree from the University of Zurich in 1869. In 1875 he became professor of theoretical physics at the Agricultural Academy, Hohenheim, in 1876 at the University of Strasbourg, in 1879 at Giessen, in 1885 at Wurzburg, and from 1900 to 1920 he held the chair of physics at Munich. He worked chiefly upon physical problems relating to the specific heat of gases, questions of elasticity, compressibility and capillary tension, absorption of heat in vapours and gases, and upon difficulties in electricity and magnetism. In the course of the latter experiments, in 1895, he made his discovery of X-RAYS, or Roentgen rays. This brought him world-wide recognition, his awards including the Rumford and Barnard medals and, in 1901, the Nobel Prize in physics. He died at Munich, Feb. 10, 1923.

ROENTGENOLOGY and ROENTGENOTHERAPY. Roentgenology also called radiology, is the science of study by Roentgen rays. These rays are also referred to as X-rays because their discoverer, Roentgen, was unable to decide their exact nature and used the symbol X (meaning unknown quantity). In 1895, Professor Wilhelm Conrad Roentgen, of Wurzburg, Bavaria, while performing experiments with the passage of electricity through a low vacuum tube, noticed that a fluorescent screen lying on a table some three meters distant shone out brightly. Further investigation revealed the fact that Roentgen or X-rays are produced whenever and wherever CATHODE RAYS encounter matter.

The Roentgen rays are classed as electromagnetic

waves. They have the particular ability of penetrating substances that are opaque to ordinary light. They cannot be seen, therefore cast no shadow; neither can they be felt.

The X-ray tube is composed of glass into which are sealed two poles or electrodes, called cathode and anode. The gas or air in the tube is then pumped out to almost a complete vacuum. When an electric current is passed through, the cathode stream strikes the anode and X-rays are generated.

Roentgen rays are invisible and are transmitted through space in the form of waves similar to the propagation of light. They travel in straight lines. They can be reflected and refracted by crystals and cannot be deflected by a magnetic field. The speed of light and X-rays is 186,000 miles per second.

Roentgen rays differ from light in wave-length; Roentgen ray wave-lengths vary from 500 to 0.06 Angstrom units (one Angstrom unit is 100 millionth of a centimeter). They will ionize gases; produce fluorescence and phosphorescence in some substances, also produce chemical changes. They produce biological changes which are probably due to chemical changes in the tissue. When a beam of X-rays strikes a substance, part of the beam may be absorbed, which means that it is transformed into radiations characteristic of that material, the process always being accompanied by the liberation of ELECTRONS or corpuscular rays. The rays in the rest of the beam are scattered or dispersed, or, in other words, have their direction altered.

The quality of the X-rays depends upon the voltage and the anode material. The lower the voltage the more heterogeneous the beam of rays; therefore, the higher the voltage, the more homogeneous they become and the greater the penetration. By interposing a filter, usually a certain thickness of aluminum or copper, a greater homogeneity of rays is also produced.

The quantity of X-radiation cannot be measured directly. One can, however, indirectly measure the intensity by a measure of the effect of radiation on a photographic plate, by fluorescence, color change, change in conductivity and ionization of gases. Certain biological tests are used; for instance, the effect on the eggs of the fruit-fly (*Drosophila*) and skin of the human being. Because of the properties just stated, the X-rays are applied in the practice of medicine; first, for treatment; second, for

The technique of the application of the X-ray as a therapeutic agent is complicated, because it must take into consideration not only the complexities of the generation of the radiation and the varying characteristics of the radiation itself, but also the biological effect as modified by a varying sensitivity, both local and general. The young growing cell, referred to as the embryonal cell, is much more sensitive than the mature cell.

It has been found that small dosages of radiation tend to activate and stimulate various functions and chemical reactions and larger doses tend to destroy. Blood vessels are at times actually closed by radiation,

with a disturbance of the blood supply. Radiation inhibits cell fermentation. Some of the cells more easily destroyed are those of the skin, intestines and hair follicles, also the rapidly reproducing cells of cancer and sarcoma; however, present knowledge of biological effect is far from satisfactory, although a fair degree of accuracy is now attained in calculating the quality and quantity of the radiation. The problem is to work out techniques in the administration of radiation in such a manner as to enable roentgenologists to arrive at a more clear-cut analysis of irradiation clinically and biologically. Biological units of radiation dosage have been measured in terms of the so-called erythema of the skin (reddening), appearing within a week or ten days, followed by tanning within about a month.

There are over one hundred disease conditions in which the judicious use of the roentgen rays is advised.

From the point of view of *diagnosis*, two methods are used; first, the *roentgenographic*, which is based upon the action of X-rays on a photographic film. Thus when the hand is placed upon a light-tight holder containing a photographic film and properly exposed to the X-ray and then developed in a chemical solution, an image of the hand is seen—not as a mere shadow, such as results when the hand is placed in a beam of light, but a shadow image of dense bone, showing all of its intricate structure, surrounded by a darker shadow image of the less dense flesh.

Various densities produce different degrees of blackness on the photographic film, which, when properly interpreted, are of significance. Thus certain foreign bodies, broken bones, diseased bones and lungs, kidney stones and gall-stones are capable of recognition. (See also UROLOGY: Diagnosis.)

The second is the *fluoroscopic* method. This is based upon the principle that certain chemicals fluoresce when exposed to the X-ray. Accordingly, a fluorescent screen was contrived which consists of a cardboard coated with barium platinocyanide or cadmium tungstate. When a part is fluoroscoped, the room is completely darkened and the part under examination is placed between the X-ray tube and the screen, and the switch turned on. The differences in density are more or less apparent, because of the variations in the degree of fluorescence. This method has special advantages in the reduction of fractures, in examination of the chest, stomach and bowels. However, it is dangerous to the roentgenologist, because he is repeatedly bombarded by the scattered radiations, which in time may produce severe changes in the blood and endocrine organs.

In properly selected cases, chemicals are injected into the blood or kidneys or urinary bladder to demonstrate the presence of gall-bladder disease or some condition involving the urinary tract. The stomach and bowels can be examined by administering opaque materials such as bismuth and barium. The cavities of the nose or spinal cord may be injected with chemicals, and the cavities (ventricles and meningeal

spaces) of the brain and the abdomen are sometimes injected with air. The uterus and fallopian tubes also are occasionally injected, so that they can be visualized.

The dangers of indiscriminate exposure to X-rays are now common knowledge. Undue exposure may produce *X-ray burns*, or severe skin disease followed by large cancerous ulceration, scaling and shedding of the nails. M. J. H.

ROESKILDE, TREATY OF, a peace instrument signed Feb. 26, 1658 by Denmark and Sweden at Roeskilde, Danish seaport on the island of Leeland. The treaty was the culmination of the rapid invasion of Denmark by the army of Charles X of Sweden, whose general Erik Dahlberg led his troops over the ice from Jutland to the islands. To avoid invasion of the entire country Denmark made peace, sacrificing nearly half her territory.

ROGATION DAYS, in the calendars of the Christian churches, occur on the three days immediately preceding Ascension Day and are observed as days of prayer, fasting and, in some churches, with litanies chanted in procession. In the Anglican Church it was customary to ask on these days for blessing on the soil, and in some English communities the ancient procession survives in the annual perambulation of the bounds of the parish. The days were instituted by St. Mamertus, bishop of Vienne (died c. 475), and they were ordered in France in 511 by the Council of Orléans. They were kept in England as early as 747. Rogation Sunday is the fifth Sunday after Easter.

ROJAS, RICARDO (1882-), Spanish-American author, was born Sept. 16, 1882, at Tucuman, Argentina, of a colonial family. His father, Absalon Rojas (d. 1893), had been Deputy in the National Congress, Gov. of the Province of Santiago and, at the time of his death, National Senator. Rojas was educated in Santiago del Estero. After being graduated from the Colegio Nacional he removed to Buenos Aires. As early as his 15th year he had made his entry into provincial journalism; he afterwards joined the staff of *El Pais*. In 1900 he became a contributor to *Caras y caretas*, and in 1904, to the powerful daily of Buenos Aires, *La Nacion*. The author of more than 20 books and a member of many learned and scientific societies, Rojas is one of the most versatile and prolific of contemporary Argentines. His books include history, travel, verse, educational treatises and literary criticism. His *Historia de la literatura argentina* is regarded as one of the authoritative works upon the subject of the national letters. I. G.

ROLAND, the hero of the early French *Chanson de Roland* who holds the pass of the Pyrenees on Charlemagne's retirement from Spain. Attacked by the Moors, he is unwilling to blow his horn for aid from the emperor. But finally when his detachment is cut down he blows his horn so powerfully that he bursts his temples and dies. There seems to have been a historic Roland, Count of Brittany, who was killed, but probably by Christian mountaineers upon Charle-

magne's retreat. Roland, a great national figure in French literature, appears in Italian as Orlando.

ROLAND DE LA PLATIERE, JEAN MARIE (1734-93), French political leader, was born near Villefranche on Feb. 18, 1734. At the outbreak of the Revolution he moved from Lyons to Paris, where he and his wife were the leaders of the GIRONDIS until that party lost popular support in 1793. After the arrest of his wife Roland fled to Rouen. When he received the news of her execution, he committed suicide at a village near by on Nov. 10, 1793. See also TERROR, REIGN OF.

ROLAND DE LA PLATIERE, MADAME (1754-93), brilliant and capable wife of Jean Roland de la Platière. She was an ardent Republican and supporter of the FRENCH REVOLUTION in its early stages. Her salon was headquarters for the Girondists during the Legislative Assembly and the first year of the Convention. In the death struggle with the Jacobins and the Girondists, she was arrested with other outstanding members of the party in May, 1793, imprisoned and guillotined on Nov. 8. During her six months' imprisonment, she wrote her *Memoires* which were published in 1795.

ROLAND FOR AN OLIVER, A, meaning a blow for a blow; an evenly matched contest, tit-for-tat. The phrase comes from the Roland legends, particularly from the 11th-12th century *Chanson de Roland*, in which Roland and Oliver, the two famous followers of Charlemagne, are depicted as matching each other almost exactly in their feats of arms and in every one of their respective achievements.

ROLFE, WILLIAM JAMES (1827-1910), American Shakespearean scholar, was born at Newburyport, Mass., Dec. 10, 1827, and graduated at Amherst College in 1849. For several years he did educational work in Massachusetts. In 1867 he published an edition of Craik's *English of Shakespeare*, which was followed by a complete edition of Shakespeare in 40 volumes, first published in 1870-83. He published other books on Shakespeare, several guides to Europe and edited a complete edition of Tennyson's poems, 1898, and the works of various other English writers. Rolfe died July 7, 1910.

ROLLAND, ROMAIN (1866-), French writer, was born at Clamecy, Nièvre, Jan. 29, 1866. He was educated in Paris and Rome and at an early age showed an intense interest in music, art and the drama. Entering the teaching profession, he subsequently became Professor of Art at the Sorbonne in Paris. In his spare time he wrote critical and biographical works on various famous men, those on Beethoven, Michelangelo and Tolstoy being outstanding. It was, however, with his 10 volume novel, *Jean Christophe*, that Rolland became an international literary figure. This colossal work was published between the years 1904-12 and in 1915 obtained for its author the Nobel Prize for literature. Strictly speaking, the work is scarcely a novel, but rather the expression of the writer's outlook on life. At the beginning of the World War Rolland went to re-

side in Switzerland, writing articles for a Geneva paper which aimed to heal the breach between France and Germany but only served to inflame the feelings of the peoples of both countries. Rolland's intense love of German music had made the idea of war with Germany intolerable, and the reception accorded to these articles deeply pained him. Among other writings of Rolland are *Mahatma Gandhi*, *Annette et Sylvie*, *L'Été* and *Mère et Fils*.

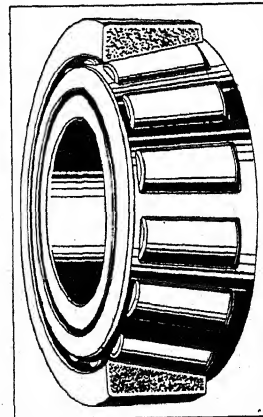
ROLLER, the common name for a family (*Coraciidae*) of medium-sized, mostly brightly colored Old World birds, allied to the motmots and todies, remarkable for the peculiar evolutions which they make in flight. The common roller (*Coracias garrulus*) breeds in southern Europe and central Asia, wintering in northern Africa and India. It is about a foot long, with a somewhat crow-like bill, broad wings and handsome plumage of pale blue, deep ultramarine and reddish-brown. Arboreal in habit, it frequents thin woods or groves, feeding chiefly upon insects, which it usually catches on the wing. Its note is deep and harsh. The nest, in which are laid four or five pure white eggs, is generally placed in a hollow tree or bank.



DRAWING BY GEORGE NIKSCH SUTTON

ROLLER

ROLLER BEARINGS, friction-reducing devices which use rollers instead of balls (see BALL BEARINGS)



COURTESY TIMKEN ROLLER BEARING CO.

CUT-AWAY VIEW OF TAPERED ROLLER BEARING

between the inner and outer races; occasionally the rollers run directly on the shaft. Some rollers are the length of the bearing while in other bearings several short rollers are used in line, usually held in place or separated by cages or rings, as shown in the figure. The rollers are usually solid and made of steel, but some are made of square or rectangular rod, wound into a helix and ground true on the outside. Bearings with tapered rollers are widely used in automobiles, in machine tools, in mechanical and electrical equipment and have been tried on locomotives. Those with both straight and barrel-shaped rollers are considerably used on railroad cars. Both roller and ball bearings are also known as "anti-friction" bearings. F. H. C.

ROLLERS, machines for packing loose soil. The usual horse drawn type comprises three drum-like sec-

tions mounted on a common shaft. A frame for supporting a seat, tongue and weighting platform is mounted on journal boxes at the ends of the shaft. Hand rollers have only one small section.

ROLLER SKATING, the sport of travel on rollers attached to the shoe, was first introduced in France, where a patent on a skate was granted in 1819. Under the impetus of the growing popularity of roller skating in that country, Austria, England and Australia, the skate underwent rapid improvement, especially when the four-wheeled skate with ball bearings was invented.

ROLLING MILLS. One of the most economical means of working steel is by the process of rolling. The ingot can be brought direct from the furnace producing it, placed on a table and run between massive rollers. These rolls have a tendency to draw the surface of the ingot through, and to compress the metal flat at the same time. By this method are produced steel plate, sheets (*see SHEETS, IRON AND STEEL*), structural shapes, and rails. In the process of rolling the metal is improved in texture.

Other methods can be used to work iron and steel into usable products, such as **FORGING** or drawing, but undoubtedly the economy of rolling is the prime reason for rendering an article of commerce that has found wide application because of its comparative cheapness. Engineers have been concerned with arranging the passes in rolling so that there will be less waste and little loss of motion. If an ingot can be handled directly to the rolls and the metal kept passing from one to the other until it reaches its final shape without undue cooling there is a great saving in cost of labor, heat and power. This has resulted in recent years in the development of the continuous rolling mill, electrically driven, that is revolutionizing the sheet industry. Metal can be passed through some of these at a speed as great as 27 miles an hour. In other words the finished sheet will be coming from the last rolls while the original ingot is not entirely through its first pass.

V. G. I.

ROLLINS COLLEGE, at Winter Park, Fla., a coeducational and privately controlled institution, was established by the Congregational Association of Florida, in 1885, but is not denominational. The productive funds in 1931 amounted to \$1,280,000. The library contained 30,000 volumes. In 1931-32 there were 490 students and a faculty of 50, headed by Pres. Hamilton Holt.

ROLPH, JAMES JR. (1869-), American merchant and mayor, was born in San Francisco, Aug. 3, 1869. Starting at 19 as office boy in a shipping firm, he rose in 10 years to a partner in Hind, Rolph & Co., marine merchants. Later he served as president of the Merchants Exchange and of the Ship-owners Association of the Pacific Coast, and in 1915 was president of the Panama-Pacific Exposition. He was elected mayor of San Francisco in 1911 and reelected for five consecutive terms, the last expiring in 1931. In Nov. 1930 he was elected governor of California.

ROMAINS, JULES (1885-), pseudonym of Louis Farigoule, French writer, who was born at Saint-Julien-Chapteuil, Aug. 26, 1885. He established Unanimisme, a kind of aesthetic Platonism, which he set forth in his book *La vie unanime*, 1908. His other works are *Mort de quelqu'un*, 1910, *Les copains*, 1913, *Odes et prières*, poems, 1913, *Europe*, 1916, and *Le voyage des amants*, 1921. Romains' plays might be said to border on caricature were they not saved by a certain human truth. *Knock, ou le Triomphe de la medecine*, produced in 1923, had a notable success.

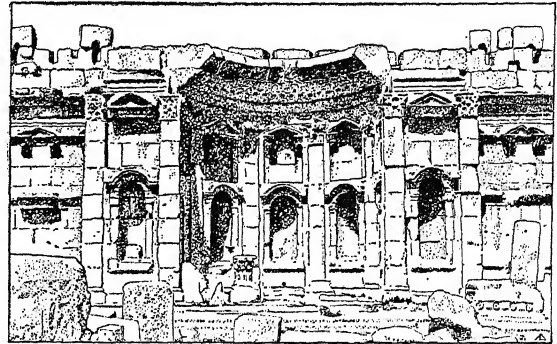
ROMAN ARCHITECTURE. Starting as a provincial expression of Greek and Anatolian architecture, Roman architecture achieved a beautiful renaissance of much that was fine in Greek columnar architecture and monumental in the Egyptian. Also, seizing the possibilities of the vaulted style, it produced under the Empire a new and wonderful civic architecture based on the arch rather than the column. These two phases of Roman architecture were propagated from one end of the Empire to the other as a uniform imperial style, with the result that a great proportion of Roman buildings, being provincial, are relatively uninteresting. But the tradition which produced them was a noble one, and it continued to be significant long after the dissolution of the Empire. The work of the brilliant school of Syria, which was active in the late Empire, formed a natural transition to the Byzantine style.

Important Periods. The dating in Roman architecture is comparatively certain, although its problems are far from solved in the case of many individual buildings. These periods are: 1000-300 B.C., Etruscan Period. The Etruscans, as masters of Rome during the greater part of this period, built in their own style, which in general resembled a countrified early Greek style, except that the true vault, regularly in stone, was an important feature of it. From 600 B.C. there was an ever-increasing direct influence from Magna Graecia and Greece itself, but never enough to outlaw the vault as an element of monumental architecture. 300-50 B.C., Republican Period. The Romans came into direct contact with the architecture of the East, then fully developed. Roman architects assimilated the grammar of Greek architecture and strove to bring their city into the current of Hellenistic architecture, and to express the predominant place of the city by architectural works. The beginnings of the monumental vaulted style were discernible in this period. 50 B.C.-300 A.D., Imperial Period, marked by a renaissance of Greek feeling under Augustus and Hadrian; development and propagation of the great imperial vaulted style of concrete construction, culminating under Trajan and Hadrian, 100-150 A.D. 300-500, Ptolemaic Period, marked by general decline; prominence of the Syrian local school; strong Asiatic influence; solution of the problem of the basilican Christian church, and basic progress on the problem of the eastern vaulted church.

Types of Building. The Romans perpetuated certain peculiarities of Etruscan architecture, such as the typical temple-base, or *podium*, with steps on the front; the wide, sometimes multiple *cella* with a deep portico, and often without a *pteroia*; the tumulus type of tomb. The Romans also built edifices of enduring character for their works of public utility. When their great building epoch came, they were called upon to produce immense civic structures where the problems were affected by engineering and practical considerations to a degree unknown in Greek architecture. It is to the eternal credit of the Roman people that they were able to rise to the opportunity and make a permanent contribution to the science of monumental planning. With perfect assurance they planned huge and complicated buildings and groups, which they executed in concrete, a basic material new to monumental architecture, and they expressed so well in these great structures the might of the Empire that even the ruins speak, with singular power, of the grandeur of Rome. This success makes it possible to forgive the uninspired detail of much Roman work.

Temples. The temple, which had long lost its unique importance, was even less a part of the real architectural problem of the Romans than it had been of the later Greeks. The Romans, maintaining the

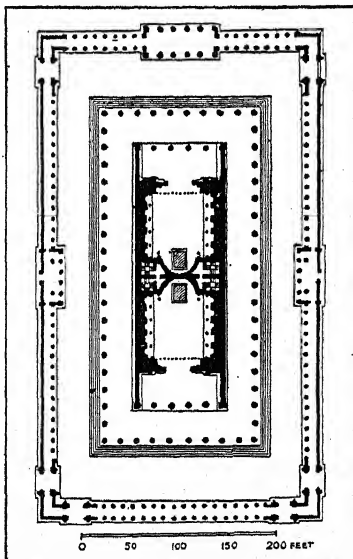
Republican times. The Pantheon in Rome, one of the finest of all religious buildings, is the *tholos* type reinterpreted and built with truly Roman scale, about 125; it is 142½ ft. in height and interior diameter.



COURTESY NEAR EAST FOUNDATION

INTERIOR TEMPLE OF BACCHUS, BAALBEK, SYRIA

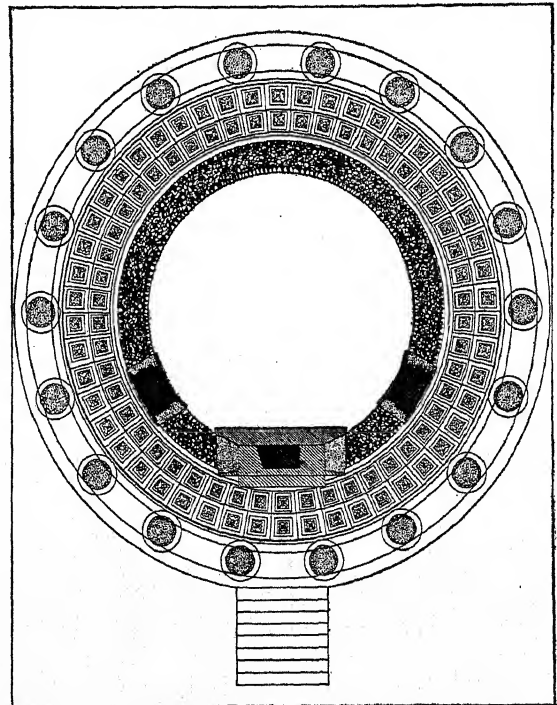
Churches. It was probably the imperial architects of Constantine after the Peace of the Church, in 311, who settled the formula of the fully developed Christian Roman basilica based on the house, the civil basilica, and other prototypes, native, Jewish and



A. D. F. HAMLIN, A HISTORY OF ARCHITECTURE. LONGMANS, GREEN & CO.

PLAN OF THE TEMPLE OF VENUS AND ROME AT ROME, ITALY

Etruscan *podium* and broad *cella* of the rectangular temple, assimilated it to the Greek type by carrying engaged columns or a true peristyle around it. Examples of vaulting occurred shortly before the Imperial Period; but the usual temple roof continued to be of timber. The largest religious project of the Romans was the prodigious group at Baalbek in Syria, 3rd century, which was built, by exception, in cut stone, and exhibited various novel features. The Romans also adopted the *tholos*, and vaulted it in late



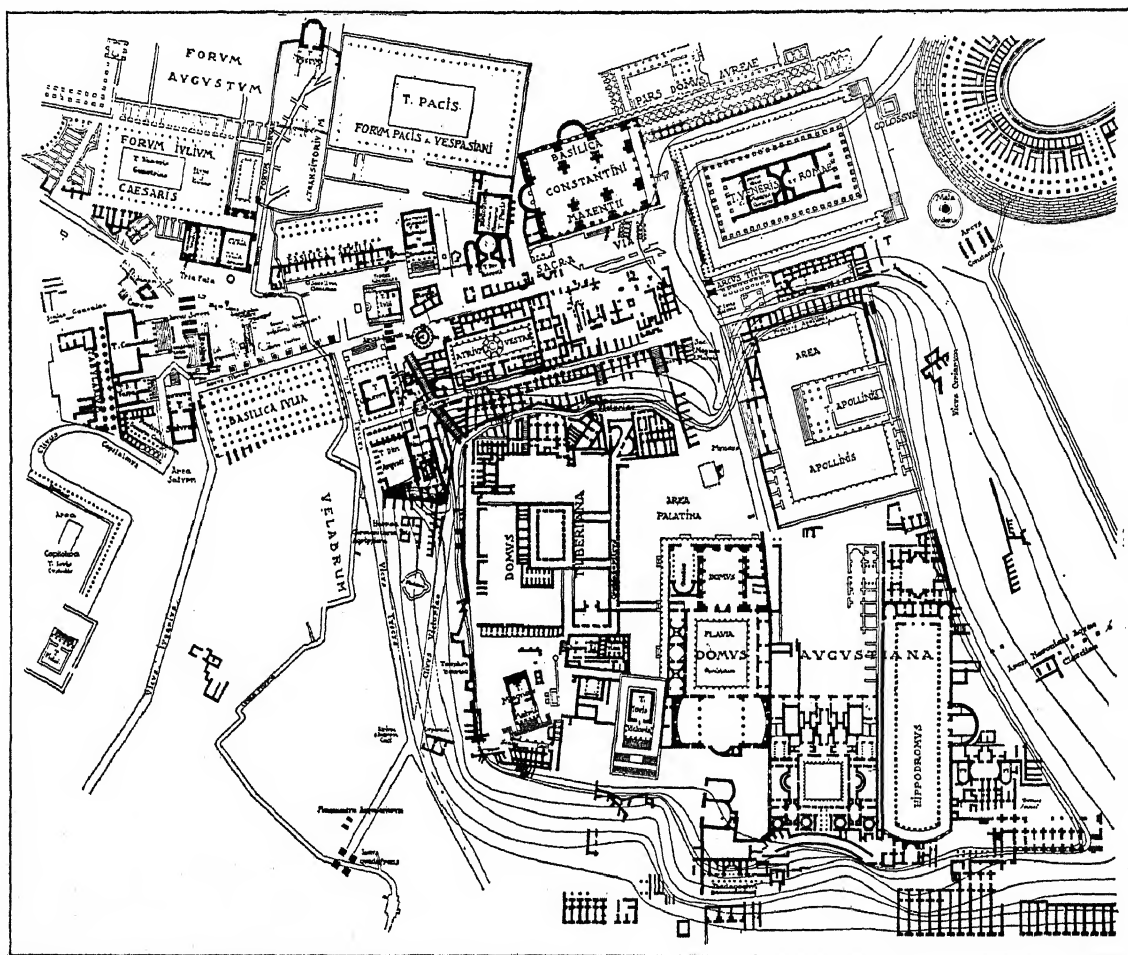
FROM G. B. PIRANESI, OPERA, VOL. V

PLAN OF THE TEMPLE OF VESTA AT TIVOLI, ITALY

Christian, in Syria. The Christian Roman basilica was fundamental in the architecture of the western church. See BASILICA; BYZANTINE ARCHITECTURE; ROMANESQUE ARCHITECTURE.

Public Places. Each Roman city had at least one forum, in origin a market place, but also a civic center and open-air meeting-place. The principal temples, halls and monuments were arranged about the forum,

known, that of Maxentius and Constantine in Rome, about 305. The aisles here were represented by three bays of transverse barrel vaulting on each side, with clerestory windows over them. The groined high vault was one of the largest ever built, being over 80 ft. across and 120 ft. high. It remained in place until shaken down by an earthquake in the 14th century. A curious local type, built on a much more modest scale in Syria, had the space cut into bays by trans-

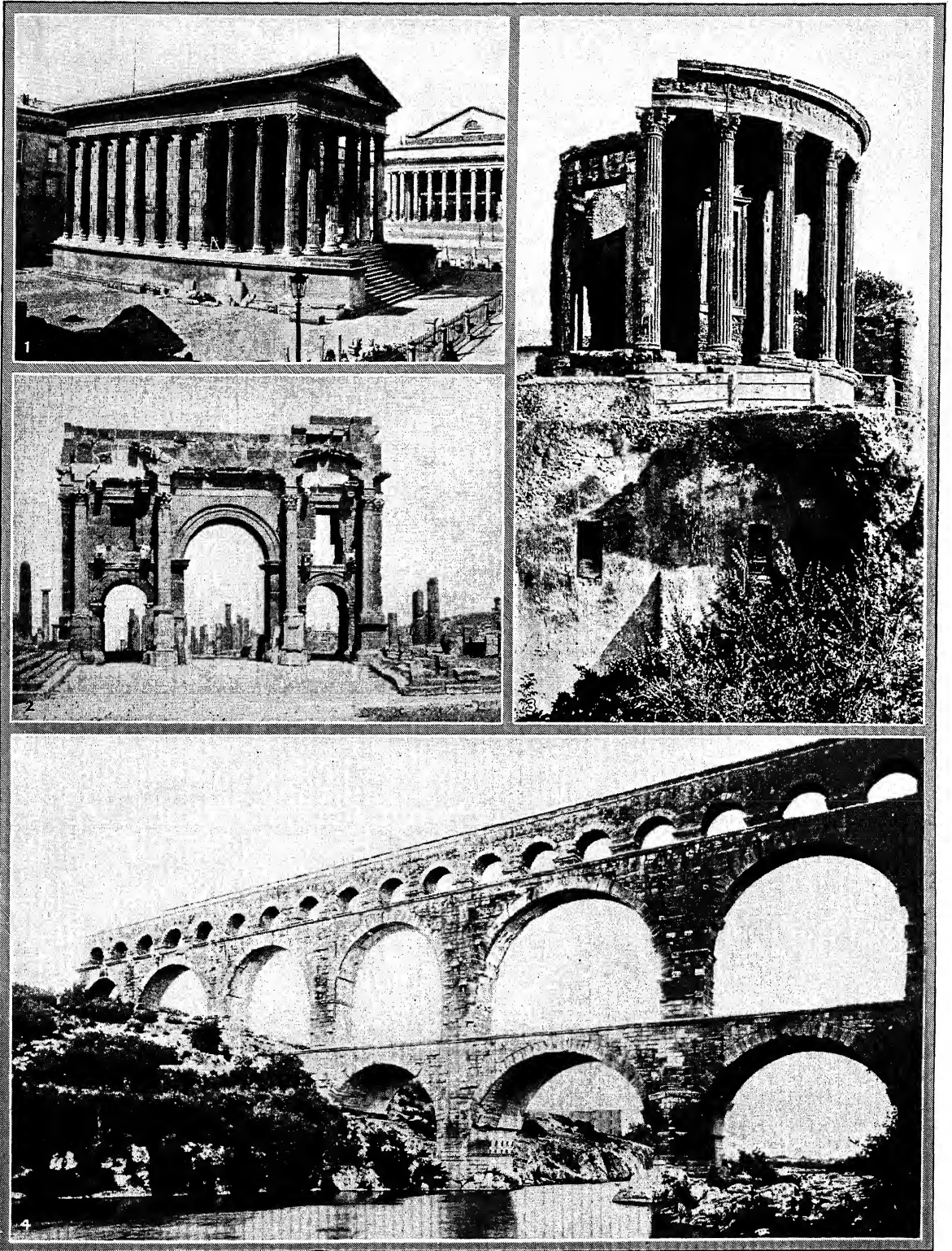


PLAN OF THE ROMAN FORUM

verse arches of stone, which supported the stone slabs of a flat terrace roof.

Thermal Establishments. Baths were important in the life of the Roman cities. They developed from the Greek gymnasium and often contained the elements of a characteristic gymnasium as well as the essential *calidarium*, or hot bath; *tepidarium*, or warm bath, and *frigidarium*, or cold plunge. The heating arrangements were often extensive and ingenious. Sometimes separate baths were provided for women. Many *thermae* were informally laid out; but the larger ones were magnificent examples of monumental planning set in parks with open areas for recreation. In such large compositions a central hall was usually added to

ROMAN ARCHITECTURE



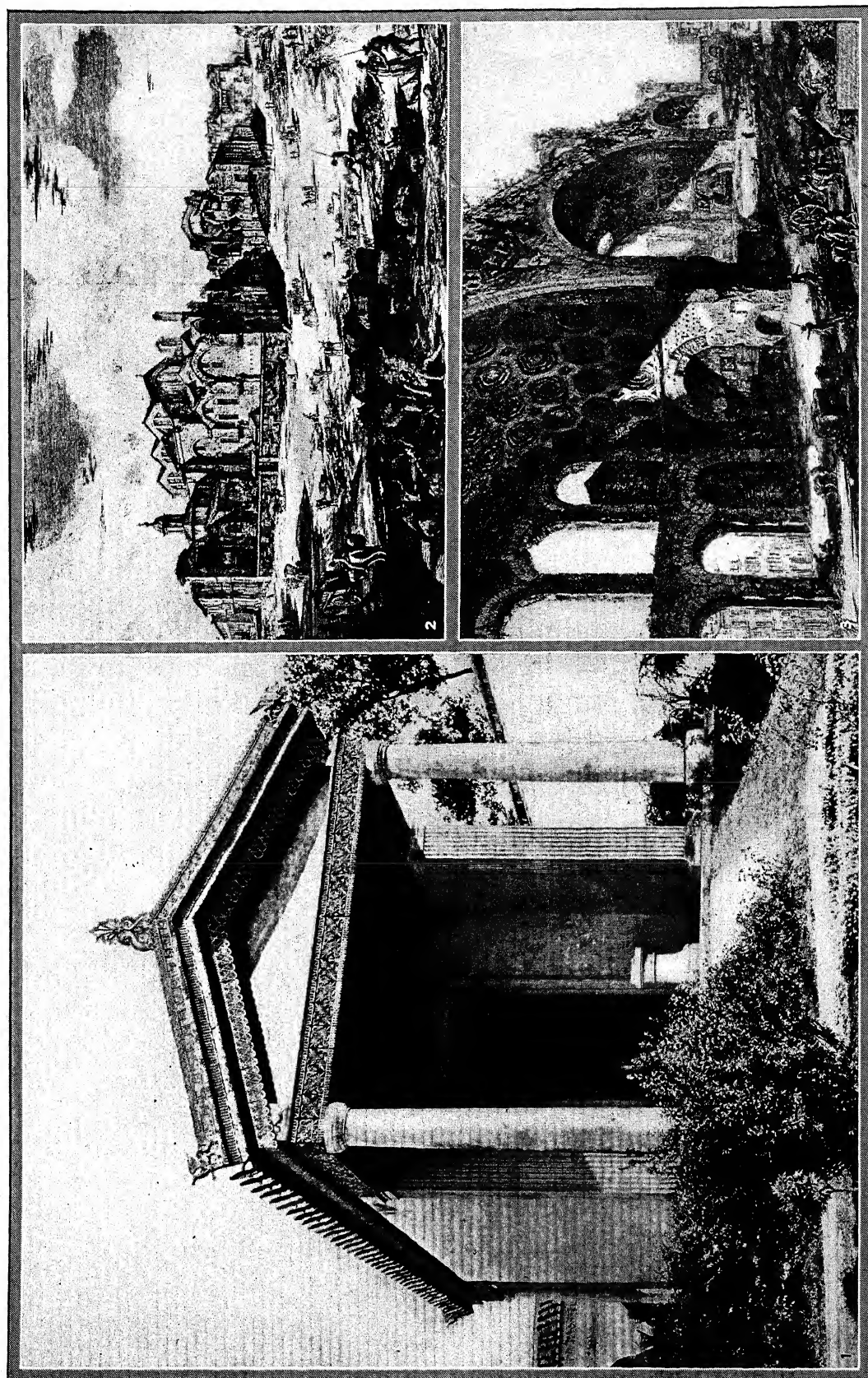
2. PHOTO FROM R. I. NESMITH AND ASSOCIATES

ARCHITECTURE OF THE ROMAN EMPIRE

1. Temple called the Maison Carrée, Nîmes, France, built about 1 A.D. 2. Arch built by the Emperor Hadrian at Timgad, Algeria. 3. Corinthian Temple of Vesta at Tivoli,

Italy. 4. The Pont du Gard at Nîmes, France, built by Agrippa in the 1st century A.D., notable for the strength and grace of its three arched tiers.

ROMAN ARCHITECTURE

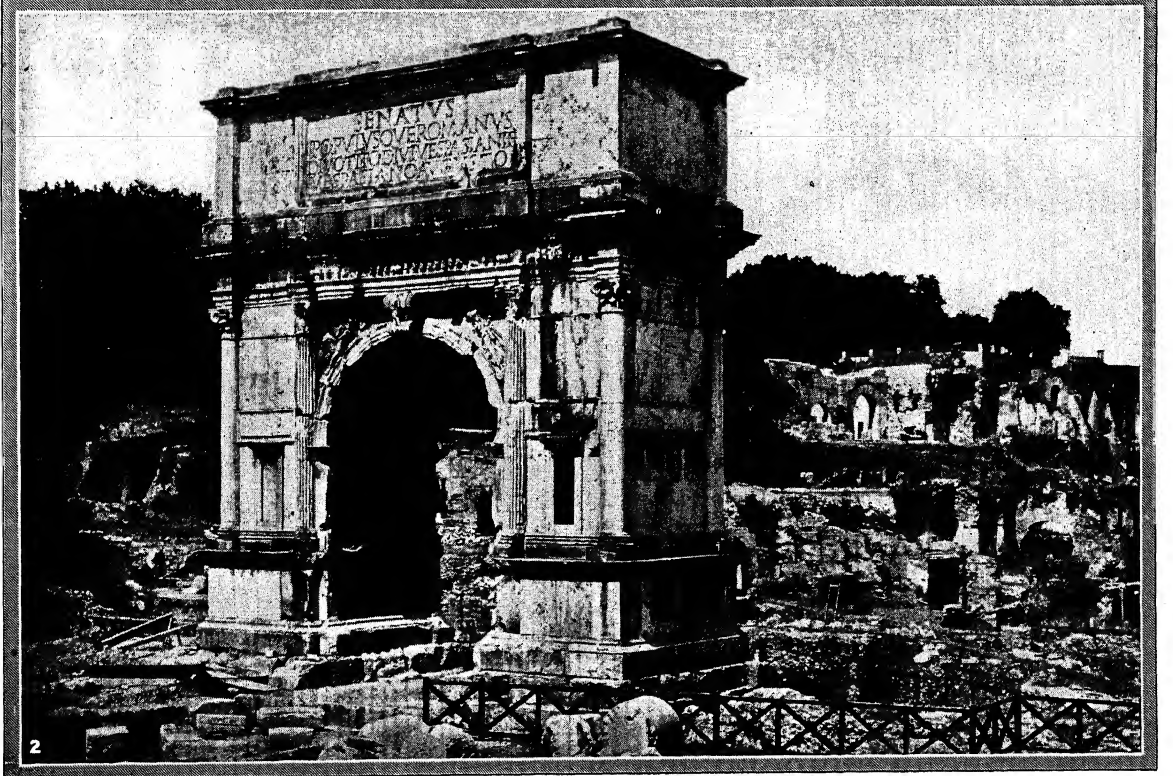
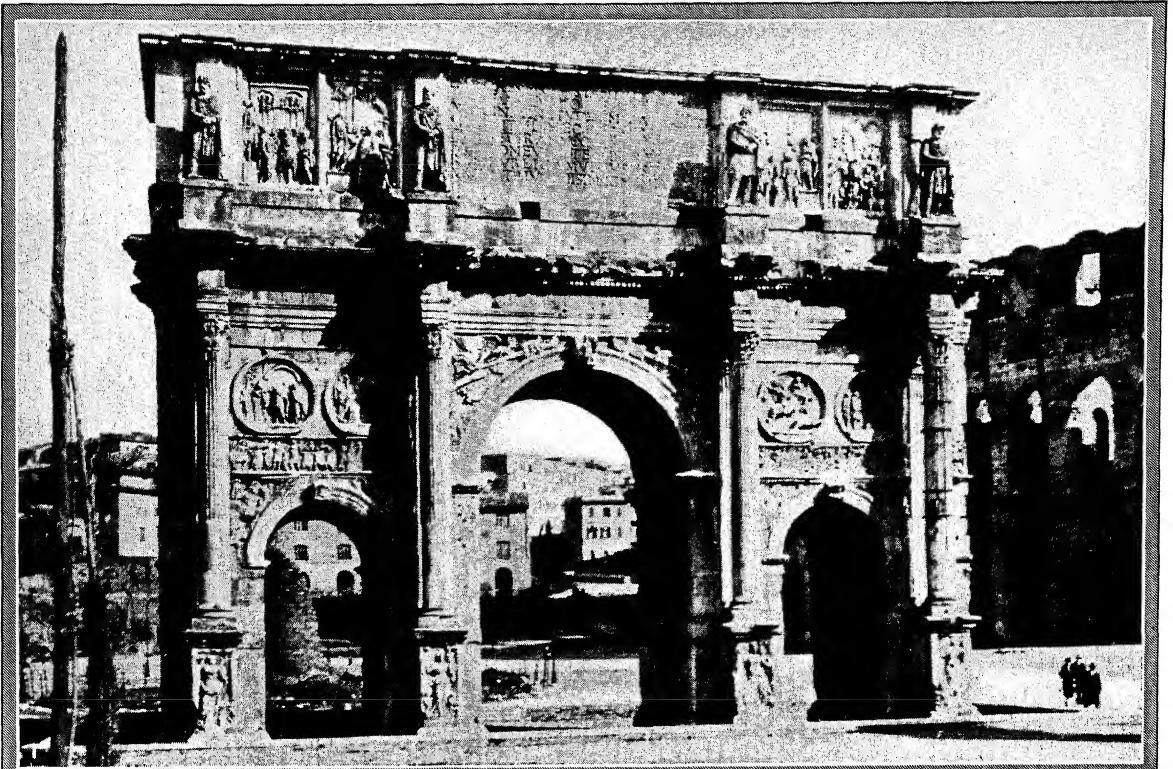


2, 3, FROM ENGRAVINGS BY GIOVANNI BAPTISTA PIRANESI (OPERA)

ETRUSCAN AND ROMAN ARCHITECTURE

1. Model of an Etruscan temple in the court of the Villa di Papa Giulio, Rome, reconstructed from remains discovered at Alatri.
2. The Baths of Diocletian, Rome, as they appeared at the end of the 18th century.
3. Ruins of the Basilica of Maxentius and Constantine, Rome.

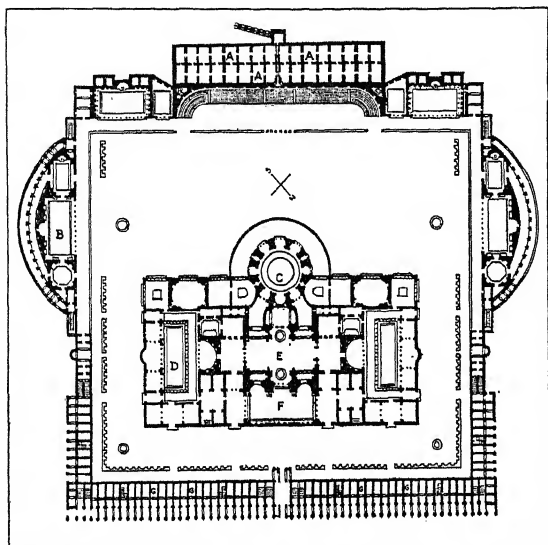
ROMAN ARCHITECTURE



TRIUMPHAL ARCHES OF ROME

1. Arch of Constantine, built in 312, celebrating that Emperor's conversion to Christianity. 2. Arch of Titus, built in 70 A.D., to commemorate the defeat of the Jews. It is ornamented with reliefs depicting the Emperor Titus.

facilitate circulation and increase capacity. The *thermae* of Caracalla, Rome, 3rd century, are an excellent example; but the type was already well developed by the time of Augustus. See BATHS.

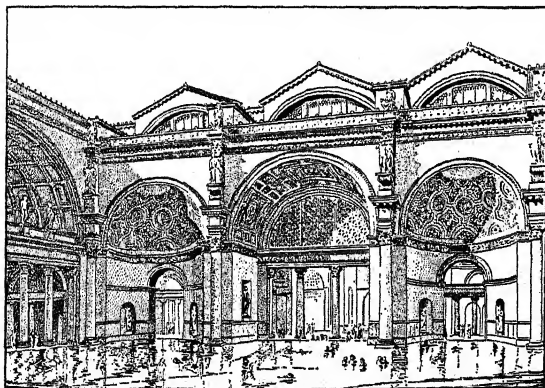


FROM E. VIOULET-LE-DUC

PLAN OF THE BATHS OF CARACALLA, ROME

A, Reservoir; B, rooms for meeting and recreation; C, hot room; D, court; E, central hall; F, swimming bath; G, shops

Theaters. These were built by the Romans according to the scheme used by the Greeks; but the Romans constructed on flat ground as a rule, using the arcaded supports of the *cavea* for corridors of ac-



FROM VIOULET-LE-DUC, ENTRETIENS SUR L'ARCHITECTURE

RESTORATION OF THE FRIGIDARIUM OF THE BATHS OF CARACALLA, ROME

cess and for shelter in case of bad weather. The curve of the *cavea* was reduced to a semicircle, as was the orchestra area. The stage took greater importance and was backed by a high wall treated with elaborate architectural motives and joined architecturally to the *cavea*. Corridors between the *cavea* and stage still occur. A promenade was sometimes added above the semicircle of seats.

Amphitheaters. As built by the Romans, AMPHITHEATERS were elliptical structures resembling two

theater *caveas* joined to enclose an arena. The arenas were used for gladiatorial combats, beast and nautical fights, and similar spectacles. The Flavian Amphitheater in Rome is the most famous; but the type was well developed before the end of the Republican Period, and large examples were numerous. The exteriors were monotonous, being treated as a rule with the repetitious Roman arch order, arches framed individually between the elements of an engaged colonnade; but the surviving ruins have a certain majesty due to their size and construction.

Circuses. These were developed from the Greek stadium by the 1st century A.D., for use in chariot-racing. The track was marked by an ornamented wall, or *spina*, down the middle; and the line of stalls, or *carceres*, opposite the turn, was focussed so that all should have a fair start. The Circus Maximus in Rome could accommodate some 200,000 spectators, and it was but the largest of several circuses situated in the city.

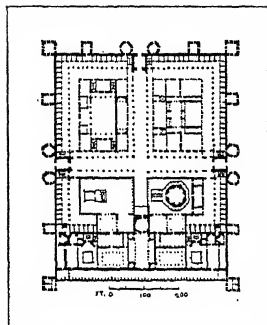
Commemorative Architecture. The Romans developed many types which have had a lasting popularity. The commemorative arch was a Roman invention which took its characteristic form, with lavish decorative sculpture, early in the Imperial Period. Columns, with spiral sculptured bands or the beaks of ships as decoration, were also used as commemorative forms. For their tombs the Romans adopted Greek and Egyptian motives; but their most striking tombs were developed from the Etruscan tumulus, which was a flat cone of earth raised over a grave, and often planted with trees. This motive was architecturalized by raising it on a tall drum, and embellished by statuary and other elements in imperial work; such were the tombs of Augustus and Hadrian. Many Romans were laid away, after cremation, in subterranean burial chambers, called *columbaria* from their many niches, which suggest a dove-cote. The catacombs were similar subterranean burial places for Christians. These latter did not cremate their dead, but provided, in the numerous chambers and connecting passages, the *loculi* and *arcosolia* in which the bodies were interred.

Engineering Works. Many works, such as bridges, aqueducts, town walls and gates, have a splendid architectonic quality due to their solid construction and frank expression. Some of them have survived in use to the present. Among the most impressive are the Pont du Gard in southern France, of the time of Augustus; the bridge at Alcantara in Spain, 2nd century, and the Land Wall of Constantinople, Istanbul, 5th century.

Domestic Architecture. This architecture ranged all the way from the breath-taking palace group on the Palatine, 1st-3rd centuries, through villas like that of Hadrian, an extensive and picturesque ensemble on a beautiful country site of the 2nd century, and of Diocletian, which was military in aspect and regular in plan, 4th century, through the houses and villas of magnates to the dwellings of more ordinary people. The Republican Romans frowned on excess and

display in domestic architecture; but this spirit changed under the Empire.

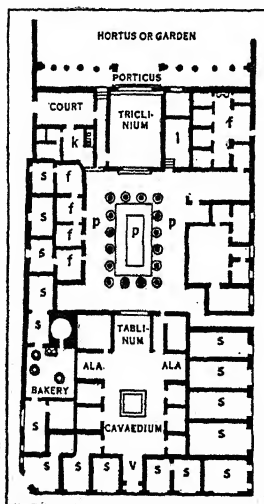
The scheme of the Etruscan house was followed by the early Romans, a simple construction often in sun-



A. D. F. HAMLIN, A HISTORY OF ARCHITECTURE, LONGMANS, GREEN

PLAN OF THE PALACE OF
DIOCLETIAN AT SPLIT, YUGO-
SLAVIA

dried brick framed with timber. The layout became more elaborate and the material better as the style progressed, particularly in the cities. In general the rooms were disposed around a central court, the *atrium*. In plain examples the *atrium* had no interior supports, merely a hole in the roof through which light was supplied to the whole interior of the house, and through which rain fell into a pool, or *impluvium*. The *atrium* was often developed into a peristylar court. At its sides were one or two little recessed sanctuaries called wings, or *alae*, and at its head was the *tablinum*, or ceremonial room of the house. Beside the *tablinum* ran a passageway serving the garden, kitchen and dining-room. On the opposite side lay the entrance passage and vestibule. Naturally the number, proportions and assembly of these elements changed according to circumstances. In the country the house would have various rustic adjuncts, including farm-buildings and pergolas, while in town it would be built wall to wall with others and might have an upper story or stories. Rarely was any attempt made to dignify the exterior of town houses; in fact shops occupied most of the house fronts. In the great cities even fireproof apartment houses somewhat resembling our own were built in the Imperial Period. In Syria there appear to have been private courts between the streets and the houses, and the upper story, often provided with a gallery, was the principal one.



A. D. F. HAMLIN, A HISTORY OF ARCHITECTURE, LONGMANS, GREEN

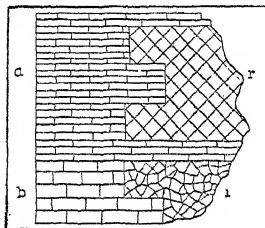
PLAN OF HOUSE OF PANSA,
POMPEII, ITALY

S, shops; v, vestibule; f, family rooms; k, kitchen; l, lararium; p, p. p., peristyles

Materials and Structure. The Romans, as practical people, were interested in cheap material, and vast numbers of ordinary buildings were built in sun-dried brick, *opus lateritium*, or rubble and timber. But the same practical bent made the Romans prefer squared stonework, *opus quadratum*, for structures of some consequence when they could afford it. By

the 4th century B.C. they developed standard wall construction, often two by two by four foot blocks, and though the softer stones like tufa and pepperino were often preferred, the Romans were using travertine and marble by the 1st century B.C. Yet it was a Rome of sun-dried brick which Augustus found, "*urbem marmoream se relinquere quam lateritiam accipisset*."

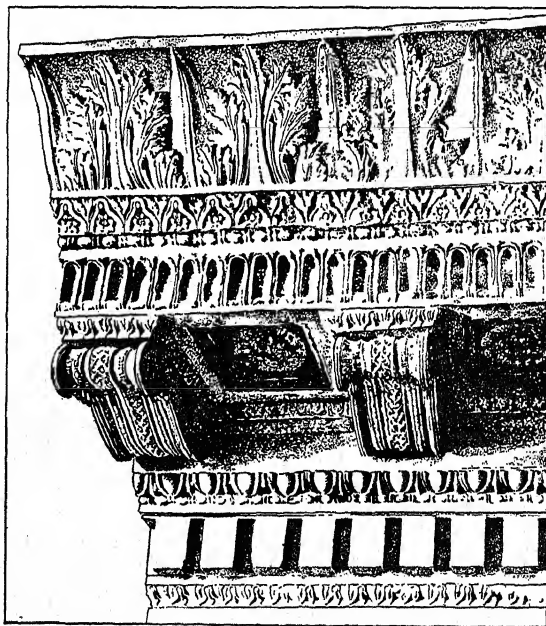
Whereas the traditional sun-dried brick was not good enough for urban construction, fine cut stonework was entirely too slow for the tempo of Roman life. Rubble concrete made with the excellent natural cement obtainable in Italy, or with a lime-mortar bond elsewhere, offered an ideal substitute. Gangs of unskilled workmen could be employed on most of the necessary processes, which could be performed on any desired scale. Concrete was deposited in form work, which could be relatively light because the concrete was faced within the forms as the wall progressed. The facing might be in rough tailing-stones, *opus incertum*; square tailing-stones in a net-like diagonal pattern, *opus reticulatum*; triangular fired brick, *opus testaceum*, or fired brick and oblong facing stones in courses, *opus mixtum*, to name the *opera* in chron-



A. D. F. HAMLIN, A HISTORY OF ARCHITECTURE, LONGMANS, GREEN

ROMAN WALL MASONRY

a, Brickwork; b, tufa ashlar; c, *Opus reticulatum*; i, *Opus incertum*



FRAGMENT OF THE CORNICE OF THE TEMPLE OF CONCORDIA,
ROME

ological order. *Opus reticulatum* became popular in Augustan times, while *opus mixtum* was used in very late work. Corresponding procedure, using skins of tile and cellular ribs of fired brick, made it possible

to build vaults freely in concrete. Domes, barrel vaults and cloister vaults were built in concrete by the 1st century B.C. and groin vaulting, a great invention of the Romans, in the 1st century A.D. The faced concrete construction was sometimes left visible, but often hidden beneath a veneer: stucco, painted or modeled in relief, and marble veneer in particular. Wonderful marble and granite columns were imported, and fittings of bronze and other materials completed the gorgeous imperial buildings. Where vaulting was not used, large spans were covered in wooden truss-work, even spans of 80 and 90 feet in the clear being undertaken. The Pantheon portico had a vault-like ceiling carried out in bronze and hung on U-shaped bronze beams. Many rooms had

light furred ceilings of vaulted form. It should be observed that the local availability of materials was important in the building of provincial variants of the Roman style.

Decoration. A large part of Roman decoration can be traced to Greek origins. It varied greatly in quality. In the Etruscan and Republican periods it was likely to be heavy or dull. It was lovely in the time of Augustus and Hadrian, more perfunctory between the reigns of these men, and increasingly degenerate after them, until it was redeemed in the proto-Byzantine period by the new Syrian method of pattern relief. At its best it was not unworthy of the edifices it adorned. The domestic interiors, many of which have come down to us, were usually well executed, but seem exaggerated in color and design to modern eyes; yet the few



ROMAN COLUMN IN ST. PETER'S CHURCH, TRADITIONALLY FROM JERUSALEM

monumental interiors still preserved to us have a splendid and austere dignity.

The column, which presented real problems of its own to the Greeks, was a mere decorative element in the most significant Roman buildings. The Romans used five orders, which were a reinterpretation of the Greek and ordinarily less subtle than their prototypes. The Corinthian was the finest of the Roman orders; but the later Romans preferred the more florid Composite, so called because the transition from shaft to *abacus* was composed of the Corinthian bell together with the Doric and Ionic *echinus*. K. C.

BIBLIOGRAPHY.—S. B. Platner, *The Topography and Monuments of Ancient Rome*, 1904; Vitruvius (Pollio), *The Ten*

Books on Architecture, trans. M. H. Morgan, 1914; G. T. Riviera, *Roman Architecture*, trans. G. McN. Rushforth, 1925; W. J. Anderson and R. P. Spiers, *The Architecture of Ancient Rome*, rev. H. Ashby, 1927; C. Huelsen, *The Forum and the Palatine*, trans. H. H. Tanzer, 1928.

ROMAN ART. The true character of Roman art as distinct from the art produced under Roman rule has only since about 1880 received serious attention, due to the efforts of modern archaeologists. If the genius of ROME did not lie in that of creative art, she gathered into her service, through her imperial policy, the diverse phases of art and gave to it a distinct character. It is now recognized that Roman art was a fusion of the artistic elements of the civilized world flowing in from Etruria, Magna Graecia and the Hellenized East, coalesced by native traits.

The earliest traces of Roman art were of Etruscan origin (*see* ETRURIA), which in turn, and from the 7th century B.C., had been dominated by Greek influence, by way of Corinth. Greek painted vases were imported in overwhelming numbers, and Roman art was otherwise affected to a large degree by the Graeco-Oriental elements in the Near East, which were brought to the peninsula by Etruscan trade in the Levant. The Etruscan artists, while utilizing the technical resources and artistic skill of the Greeks, retained a native rugged style and fidelity to life in the expressive vitality of the human form, which was later to become the dominating idea of Roman realism. In 1917 discoveries were made at Veii of a terra cotta Apollo by Vulca of the 6th century B.C. and the bronze *Wolf of Rome* was assigned to the early 5th century. Tomb wall-paintings at Corneto of the same period were found of a high order.

Motives of sculptural relief and sepulchral urns of the 2d century were revived by the imperial age. One after another of the Etruscan cities were subdued and their art treasures swept to Rome. From Volsini alone, in 265 B.C., 2,000 bronze statues were taken. With the conquest of Veii, in 396 B.C., Etruscan art was absorbed into that of Rome. Greek influence from the south and north steadily increased as the Roman legions repeated the process of subduing and methodically pillaging one Hellenic city after another. With the capture of Corinth by Memius in 146 B.C., GREEK ART in its turn entered the service of Rome and was called upon to represent subjects according to Roman ideals. Rome now became the undisputed master of the two richest art centers and both thereby gained new life, and entered a new phase of normal development. The decadent Etruscan and Greek strains were revived and tempered, and enriched by the fresh influences Rome had herself derived from her new dominion in the East. The diverse streams of the realism of Latin art, the artificiality of Greek culture, and the plastic elegance and beauty of the East were directed into a single channel, Rome taking the leadership of art along with the leadership of the civilized world.

The character of Greek art was ideal, centered around a state religion; that of Rome was essentially

realistic and historical, leading to the central motive of the deified emperor. This distinctive national Roman art found expression in portraiture, equestrian statues, historical reliefs of continuous narration, triumphal arches and monuments, and sarcophagi decorated with reliefs, depicting the military exploits of the deceased, disguised as mythology. Practically every great political and military event had an effect upon Roman art. The rapid succession of conquests, in which works of art were the coveted spoils of war, led to increasingly magnificent pageants of triumphant generals, who in their processions exhibited chariotloads of foreign pictures and statues. This form of triumphal pageant began with the sacking of Etruria, and was resumed by Marcellus in 212 B.C., after the downfall of Syracuse. Fulvius Nobilior displayed 230 marble and 2,850 bronze statues taken from the collection of King Pyrrhus at Ambracia, in token of the defeat of the Aetolians in 187 B.C. PLUTARCH describes the 250 chariots laden with pictures and statues brought home by Aemilius Paullus, while PLINY says that Mimmius "filled Rome with sculpture," the spoils of Corinth in 146 B.C.

While foreign paintings were pouring into Rome in these triumphal trains, a national school of painting was being formed through the demand for illustrating these triumphs and the decoration of edifices in commemoration of them. Among the first of these, fragments of which are extant, were: the Esquiline frescoed tomb-painting of the 4th century B.C., Italic in motive but with the Hellenic superposed frieze of figure arrangement which was to become the main factor of Roman triumphal reliefs; the paintings in the Temple of Salus, 303 B.C., attributed to Fabrius Pictor; the Pacuvius decorations in the Temple of Hercules and the Lykon decorations in the Temple of Juno.

Paintings on wood were carried in the triumphal processions depicting military exploits in the form of heroic legend, the conquered cities personified as allegorical figures following the chariot of the victor. This was an old Greek conception adapted to Roman demands. The most celebrated of this type was painted by Metrodorus, illustrating the victory of Aemilius Paullus over King Perseis of Macedonia in 186 B.C. The numerous victories of the Scipios were marked by this practice, 135 personifications of conquered cities appearing in the procession of Scipio Asiagenus. The dramatic series of paintings of Caesar's triumph in the civil wars of 46 B.C. surpassed all others in realistic grandeur (*see CAESAR, JULIUS*). These historical battle-paintings made excellent political propaganda for the triumphant general seeking election to consulship. His portrait was also exhibited in a conspicuous place, later to be dedicated in a temple. Noteworthy among these is the portrait of SULLA painted after the siege of Nola, in 88 B.C., and that of MARIUS after his victorious return in 87 B.C.

Portraiture was, however, more closely associated with sculpture, which arose from the custom of the

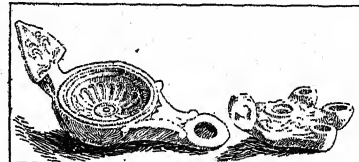
moulded wax image of the deceased being carried in funeral procession and later deposited in the entrance hall of his house. These ancestral images as they were transferred into terra cotta bronze, or stone, show the blending of Etruscan and Greek naturalistic treatment. Among the earliest extant are the bronze heads of the first Brutus, of the 4th century, and that of a young athlete, about 200 B.C.; other preserved examples are heads of POMPEY and CICERO, and one of Caesar in green basalt.

The effect of the rapid succession of conquests, with the attendant direct contact with older civilizations and the overwhelming volume of unsurpassed works of art flowing, into Rome, was an inevitable check on growth from within. This, together with the effort of the Romans to rid themselves of the stigma attaching to *barbari*, or outsiders, and to increase their prestige by entering into the charmed circle of Hellenized culture, led to a mania for collecting. Rome became the greatest museum in the world. Works of Pheidias, Praxiteles, Scopas, and Lysippus were set up in the temples. Wealthy patricians and victorious generals made vast private collections. When originals could not be obtained, skilled Greek artists were called upon to copy or adapt beautiful and famous works. An era of copying and imitation set in, with little or no originality. About four fifths of extant antique collections are made up of these copies, particularly those of the 5th century B.C.

With the Augustan age, Rome became the center of Hellenized culture as Alexandria and Pergamun had before her. The activities of Hellas and the Hellenized Orient were brought under her absolute leadership; not as a continuation of Hellenized art, but as the native strength of Latin art, plus new Hellenic influences. It was this genuine native element that saved Roman art from being submerged by Oriental influence. Roman art by proposing new subjects and



VENUS GENETRIX
A copy of a statue
attributed to Arcesilaus
1st century
A.D.). In the Louvre,
Paris

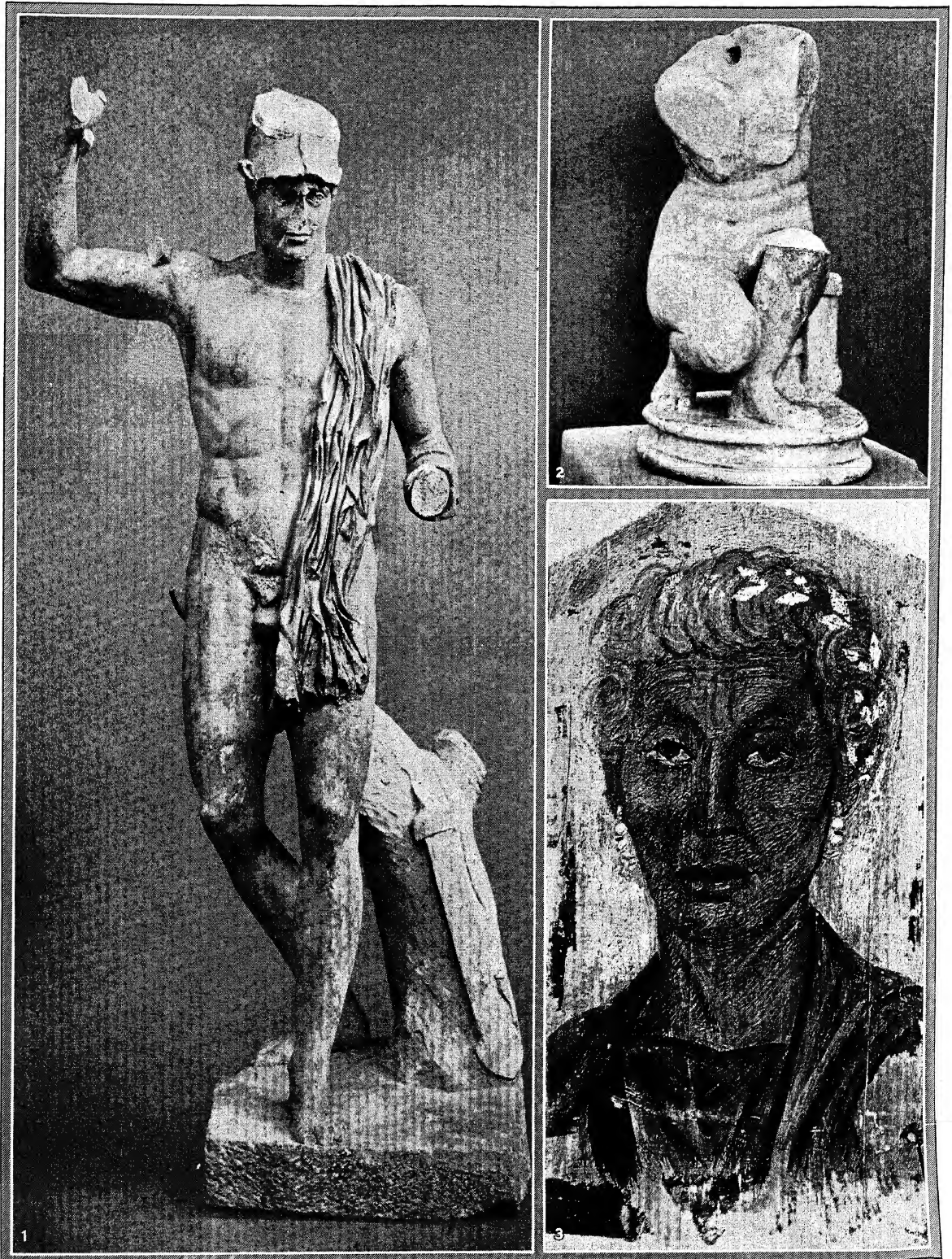


COURTESY M. M. OF ART

ROMAN TERRA COTTA LAMPS OF THE 1ST
CENTURY A.D.

fresh ideals, fashioned on its own civilization, brought new and vigorous life to an artistic form that had become sterile and had lost its significance, and Greek art grew and struck roots in a soil rich to receive it. Augustan art was one of transition, a pioneer art treading new paths. The characteristic feature devel-

ROMAN ART

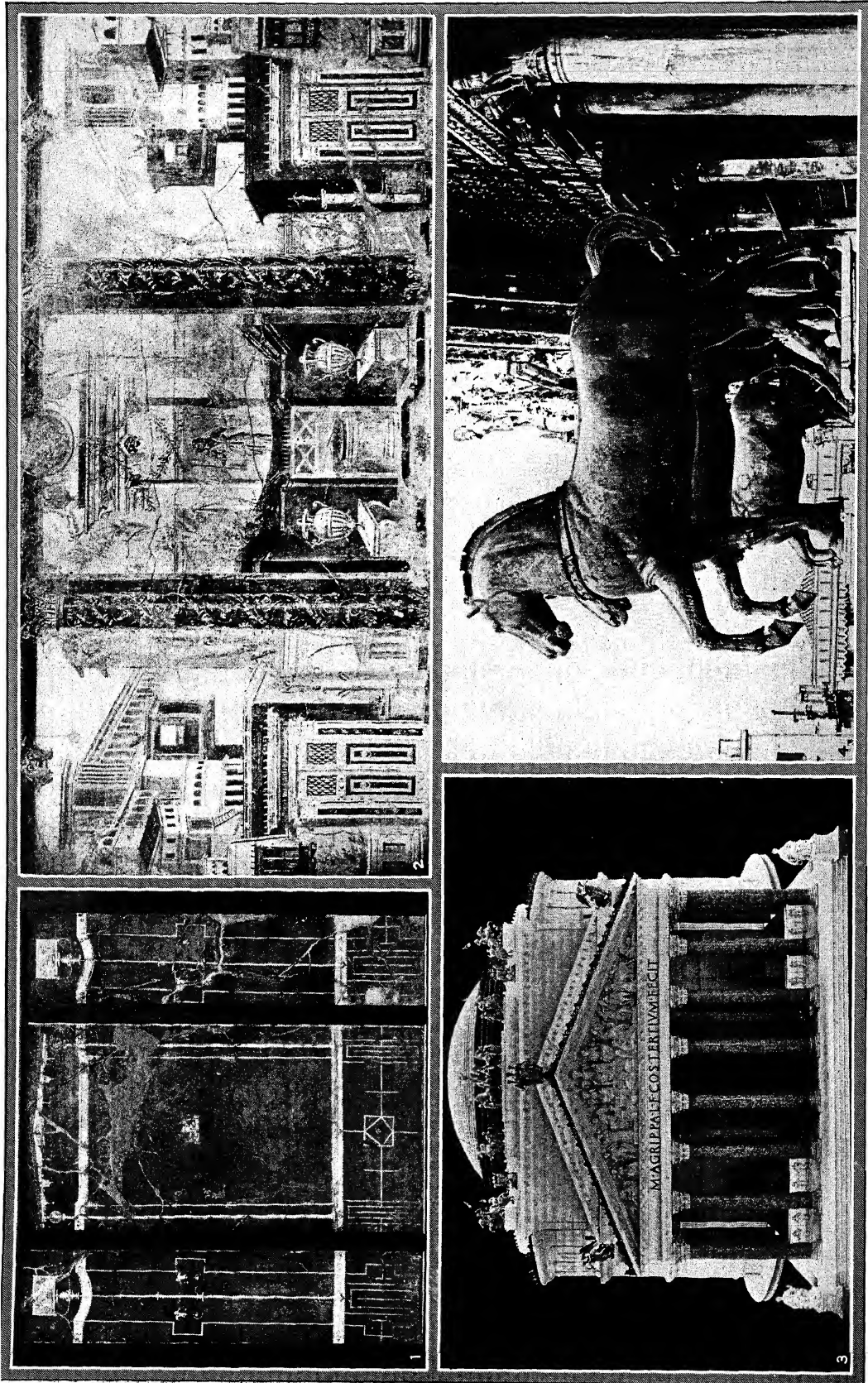


COURTESY METROPOLITAN MUSEUM OF ART

GREEK INFLUENCE IN ROMAN ART

1. Protésilas, a Roman copy of a Greek sculpture, 450-440 B.C. 2. Crouching Venus, copied from a Greek sculpture, 3rd century B.C. 3. Portrait on panelled wood, from Fayum, Egypt, dating from the 2nd century A.D.

ROMAN ART



1, 2, 3. COURTESY METROPOLITAN MUSEUM OF ART

ART OF THE ROMAN EMPIRE

1. Frescoes on a black ground from a villa at Boscoreale on the south slope of Vesuvius (31 B.C.-50 A.D.).
2. Frescoed wall of the 1st century B.C. from Boscoreale, Italy.
3. Model of the Pantheon at Rome, built by Agrippa and restored by Hadrian.
4. The famous bronze horses of St. Mark's, Venice.

oped through the Imperial age was the glorification and deification of the emperor, as in Egypt all centered around the king.

Distinctive Roman art forms taking rise at this period were the substituting of marble for less splendid building materials, through the discovery and working of the quarries of Carrara; historic relief and continuous narration; greater realism in portraiture; and naturalistic decoration treated as an integral part in a composition. The great artistic achievement of the Augustan age, the embodiment of these forms, was the *Ara Pacis Augustae* completed in 9 B.C. in honor of the emperor's victories in Gaul and Spain.

The *Arch of Titus* was a further step in continuous narration of the historical present, and a meeting by sculpture of the problem of producing the illusion of the third dimension of unlimited depth and space. It depicts the triumph of Titus over Jerusalem and the capture of the sacred vessels from the temple. The column of *TRAJAN* at Rome stands as one of the greatest creations of human genius in the plastic arts. "An epic in stone," it is continuous narration raised to its highest power. It gives the story of Trajan's triumph over the Dacians in an uninterrupted succession of events, in a steady upward movement in 23 windings of the column in a band about a meter wide; 2,500 figures are spread along the ribbonlike scroll of 200 meters. Trajan appears about 90 times the center of every situation, but the pictorial representations of fighting are relieved by the humor of camp life. No detail of landscape, architecture or costumes is omitted. Gesture and expression not only aid realistic effect but vitalize the subject. The column is supported on a base, decorated with trophies of war, which formed the sepulchral chamber destined to receive the remains of the emperor. It is crowned by a gilt statue of Trajan. Sixty years later the column of *MARCUS AURELIUS*, a further adaptation of the continuous style, was to strike a finer note in conveying the more humane attitude of the philosopher-emperor toward his foreign prisoners. The reign of *HADRIAN*, the "Greekling," was a short-lived return to "classicism" and imitation of archaic models, without original accomplishment, with the possible exception of the Antinoüs cult portraiture. The growing popularity in Hadrian's time of the elaborately sculptured sarcophagi was marked by increasing Oriental influence, not only in manner but of the Mithraism in sepulchral imagery.

The study of Roman painting is usually confined to the evidence offered by the excavations of *POMPEII* and in the neighborhood of Rome, where the volcanic ash has preserved the texture and brilliancy of coloring close to its original state. About 3,500 mural decorations have been recovered and suggest Greek workmanship or copies from Greek originals. They cover an uninterrupted period from the late Republican age to the destruction of the city in 79 A.D. Four styles of painting are commonly recognized, corresponding roughly to the successive methods of building construction. The first is known as the Incrus-

tation style, or "painting with marbles." The unbaked brick walls were veneered by inlaying slabs of marble, porphyry, or basalt of one color in those of another, to achieve rich polychromatic effects in geometric or figure patterns. The house of Sallust is a typical example. Imitation varicolored, painted paneling was used in the humbler dwellings.

The second or Architectural style extends from about 380 B.C. to 10 B.C. In this the new process of fresco painting replaces the incrustation mode. Brilliantly colored pictures occupy the central wall panels, set in a framework of elaborate architectural design to produce an illusory perspective. In this period



FOUNTAIN FROM A WALL PAINTING IN A VILLA AT BOSCOREALE, ITALY (1ST CENTURY B.C.)

were initiated the tendencies which were developed in the third and fourth styles. The architectural effect ranged from a grandiose imitation of a real building to the illusion of an extensive garden enclosed by the representation of a low fence, to give unity to the composition. The yellow frieze from the villa of Livia is of this period, as also the *Odyssey Landscapes*, discovered in 1849 on the Esquiline. They are a series of eight panels depicting the wanderings of Odysseus, and are the finest type of ancient landscape. Illusionism has here reached a high grade of development. The *Aldobrandini Marriage*, discovered on the Esquiline in 1600 by a cardinal by that name, is one of the finest examples of ancient painting technique.

In the third or Ornate style, from 10 B.C. to 50 A.D. architectural elements are subordinated to elaborate ornamental borders framing the central panel painting. This was the period of the fashionable "villa landscapes" and of "illusionism." The fourth or Intricate style existed until the destruction of the city in 79 A.D. The pictures are in the form of easel paintings, and in many cases copies of well-known Greek masters. It is on these that the study of Greek painting is based. Antiphilus was the great illusionistic landscape painter of the day. Portrait painting was as realistic as sculpture. The Fayum portraits, discovered in northern Egypt within the present century, are painted in encaustic on wooden panels. The discovery of *Flora* at Stabiae, near Pompeii, shows a mastery of impressionistic technique combined with a freshness and delicacy not often reached by the French *plein air* artists. The filmy garments are gently blown by the wind and the whole effect is beautifully luminous.

In decoration, in both painting and sculpture, Roman art is seen at its best. The development of the *RINCEAU* is purely Roman and is one of the greatest contributions to ornamental design; a spiral scroll

based on the acanthus, skillfully varied, yet marvelously true to nature. The foliage is teeming with bird and insect life. This motive was later to play an important part in Renaissance ornament. Mosaic was carried on along with painting, and is noteworthy in that it preserved to posterity one of the most famous Greek paintings by Philoxenus of about 300 B.C., the *Alexander and Darius at the Battle of Issus*. The minor arts, appealing to the Roman love of the practical and sumptuous, were highly developed. Gem-carving reached a high point of perfection through the use of a signet ring as a personal seal. Carved gems had also a necromantic value. Cameo-cutting was carried to the extent of the most exquisite portrait relief as seen in the portrait of Julia, daughter of Tiberius.

BIBLIOGRAPHY—F. Wickhoff, *Roman Art*, tr. by E. Strong, 1900, E. Strong, *Roman Sculpture from Augustus to Constantine*, 1907, H. B. Walters, *Art of the Romans*, 1911; H. Stuart Jones, *Companion to Roman History*, 1912, Élie Faure, *History of Art*, 1921-24; M. H. Swindler, *Ancient Painting*, 1929.

ROMAN CATHOLIC CHURCH. The Catholic's conception of Church history is based on his conception of the Church. In his eyes the Church is the society founded by the God-Man Jesus Christ to carry on till the end of time his work for the salvation of mankind. On the eve of his departure from this world Christ delegated to his apostles his own threefold office of priest, prophet and king (Matthew 28:18-20). After his Ascension they and their successors were to sanctify, teach and guide mankind. He thus made the Church the ordinary medium of salvation for all men. The Church discharges the threefold office committed to her by applying the fruits of the Redemption to each individual soul through the Sacraments and the Sacrifice of the Mass; by preserving and preaching the truths revealed by her Divine Founder, and by guiding the faithful through her laws and precepts on the way of salvation.

Since the Church has been commissioned by Christ to teach all revealed truth, every Catholic considers it his duty to accept her teaching: the doctrinal pronouncements of her visible head, the Pope, and the decrees of the Oecumenical Councils, as messages of the infallible God Himself. Since the Church has the duty to "dispense the mysteries of God," the Catholic has the duty to make proper use of the means of grace and salvation offered to him. Since the Church has the power to regulate the religious and moral life of her members, it is the duty of the Catholic to submit to her laws and to observe her precepts; to honor those invested with her authority and to contribute the material means necessary for the efficient administration of their office.

The Church is not of this world, and hence it cannot be explained, like earthly institutions, from natural causes. As the creation of the God-Man, equipped with supernatural powers and destined for an eternal end, she is a lasting miracle, a heavenly phenomenon in this visible world.

But this "mystical Body of Christ" lives in time and space, in this imperfect world. Men with all their virtues and vices and failings make up her membership, and she is affected, for better and for worse, by the constant changes taking place in the life of humanity. Hence the Church has a history. When poring over the pages of that marvelous story the enlightened Catholic never loses sight of the fact that two factors are active in the Church, the divine and the human. The divine will of necessity be always beautiful, holy and sublime, not so the human. The Catholic recognizes the divinity of the message which Christ teaches through his Church, though the messengers may frequently be very human. This is the Catholic's idea of the Church.

Foundation of Church. Christ founded the Church when, a year before his death, he said to Simon, the son of Jonas: "Thou art Peter, and upon this rock I will build my church, and the gates of hell shall not prevail against it." (Matthew 16:18.) After his Resurrection he confirmed Peter as the visible Supreme Head of this Church when he said to him: "Feed my lambs, feed my sheep." (John 21:17.) The founding of the Church was completed on Pentecost Day, when the Holy Ghost descended upon the disciples who were assembled in Jerusalem with Mary, the Mother of Jesus. Filled with "power from on high," the apostles issued from the upper room and faced the great crowd that had gathered in the city from all parts of the world for the festival. Peter's eloquent sermon was followed by the conversion of 3,000 men and women. In a few days their number grew to 5,000.

Bloody persecution swept over the infant Church in Jerusalem; but it only served to spread far and wide the doctrine which it was intended to destroy. Philip, one of the seven deacons, received the first Gentile into the Church. Peter baptized the first Roman and all his house. At Antioch, the metropolis of the East, the converts from paganism were so numerous that the followers of Jesus were called Christians, to distinguish them from the Jews with whom they had heretofore been identified. Saul, the most fanatical of the enemies of the new religion, miraculously converted by Christ himself, who appeared to Saul in his glorified humanity, began, as Paul, the systematic conquest of the Roman Empire for his Divine Master.

Twenty years after the ascension of Christ, the Church, in the Council of Jerusalem, took the bold step of breaking away from the Jewish religious customs and traditions. She emphasized her catholic, that is her international, universal character. She wished all men to understand clearly that the religion preached by Christ was something more and better than a mere reform of Judaism. The decree issued by this council of apostles and elders bears the clearest testimony to the fact that there existed from the beginning in the Church of Christ a teaching authority whose duty it is to decide, with the assistance of the Holy Ghost, all questions pertaining to faith and

morals: "It hath seemed good to the Holy Ghost and to us . . ." (Acts 15:28).

The martyrdom of St. Peter and St. Paul at Rome and the destruction of Jerusalem, 70 A.D., shifted the center of ecclesiastical life and government to the capital of the Roman world. The government of the Church passed from the Apostles to their successors, the bishops, priests and deacons. The bishop was the head, shepherd, judge and representative of the Christian community, its bond of union and the presiding officer in its public worship (liturgy). The priests were the advisors of the bishop, and his vicars when he was absent or incapacitated; they were also the official instructors of the candidates for baptism (catechumens). The deacons, though the lowest in rank in the hierarchy, had greater power and influence than the priests, because they were the administrators of the temporal affairs of the community and the immediate assistants of the bishop at divine service.

Rapid Growth of Christianity. Before the death of St. John, the last of the Apostles, about 100 A.D., the Christian religion was firmly established in most of the provinces of the Roman Empire. In the course of the 2nd and 3rd centuries it spread beyond the limits of the Empire to every part of the known world. By 250 its position was so impregnable that the systematic persecutions which began at this time could not hinder its final victory. At the beginning of the 4th century about half of the people of Asia Minor, Greece and Egypt had been converted, and there were flourishing churches in Persia, Armenia, Arabia, Abyssinia, Syria, Italy, Northern Africa, Spain, Gaul and Britain. It has been estimated that at this time there were more than 4,000,000 Christians in the Roman Empire alone. The prophecy of Jesus had been literally fulfilled: the grain of mustard seed had become a tree, which had begun to cover the earth with its branches.

Many circumstances favored the rapid growth of Christianity; but there were obstacles to be overcome which, humanly speaking, were utterly insurmountable. The period of her phenomenal expansion is the *heroic age* of the Church, the age of the martyrs, the age during which the profession of Christianity was a heroic venture. We cannot understand the true character of Christianity unless we bear in mind that, for three centuries, to be a Christian meant a summons to martyrdom. "Let the Christians be exterminated!" This was, according to Tertullian, the laconic edict which ushered in the Neronian slaughter of the followers of Christ, and it remained the rallying cry of paganism until the last pagan emperor bowed before the standard of the Cross. The victory of Christianity over paganism was the purest ever won. For it was won "by witnessing and enduring, by loving and suffering, by pouring out innocent blood. It was won by weak men and women, slaves often, opposed to the mightiest of governments and all the social and intellectual pride and prejudice of the civilized world."

Whilst the conflict between paganism and Chris-

tianity was still undecided, the Church gained a signal victory over a whole brood of heresies centering about the problem of evil and known collectively as Gnosticism. By this triumph she turned back from her fold the tide of un-Christian influences which had threatened her very life almost from the beginning of her existence. The battle with paganism had produced those staunch defenders of Christian doctrine and practice known as the Apologists, St. Justin, Minucius Felix, Clement of Alexandria, the Author of the Letter to Diognetus, Tertullian and ORIGEN. The controversy with the Gnostics brought forth the first important work of Catholic theology, the "Refutation of All Heresies" by St. Irenaeus of Lyons. Thus Christian literature was born and nurtured in the storm and stress of conflict.

Official Religion of the Empire. The Edict of Milan, 313, granted tolerance to the Christians. During the 4th century Christianity gradually supplanted paganism in public and private life. The founding of Constantinople by Constantine the Great, 330, was undoubtedly by a stroke of genius, but it was also the first step in the estrangement of the Eastern from the Western Church. Julian the Apostate's attempt to revive the dying paganism of ancient Rome was only an episode, a "little cloud that hurried by," as St. Athanasius phrased it; but the Arian heresy (*see* ARIANISM), which repudiated the fundamental doctrines of Christianity and degraded Christ to the rôle of a Greek demi-god, was a raging flood to which the indefectible Church of God seemed for a time to have succumbed. After a long struggle Arianism was overthrown, and Catholic Christianity became the official religion of the Empire, 380. Other heresies, theological and christological, followed in the wake of Arianism; two of them, Nestorianism (*see* NESTORIANS) and Monophysism (*see* MONOPHYSITES), led to schisms which persist in the East to this day. It was the age of the great Oecumenical Councils: Nicaea, 325; Constantinople, 380; Ephesus, 431; Chalcedon, 451, and of the great fathers and doctors of the Church: ATHANASIUS, Basil, Gregory, St. JOHN, CHRYSOSTOM in the East, AMBROSE of Milan, St. JEROME, and AUGUSTINE of Hippo, in the West. This period also saw the rise and rapid development of MONASTICISM, an institution which was destined to play such an important part in the subsequent history of Europe and the Church.

Whilst the Church was struggling against heresy and schism for the truth and life given to her by her Divine Founder, countless barbarians poured in upon the Western Roman Empire. When that huge fabric crumbled at last before the onslaughts of the Germanic tribes, the Church, conscious of her eternal mission and inheriting all that was best in ancient culture, set to work to Christianize and civilize the barbarian invaders. Her chief instruments for the accomplishment of this gigantic task, the work of centuries, were prepared by the conversion of Ireland through the labors of St. PATRICK and the foundation of Benedictine monasticism by St. BENEDICT OF

NURSIA. With St Gregory the Great (*see* GREGORY), 590, the first monk ascended the throne of Peter. His pontificate ushers in the period of history known as the Middle Ages.

The five centuries which elapsed from the beginning of the pontificate of Gregory the Great to the formation of the Christian Commonwealth of Europe in the second half of the 11th century were marked by marvelous missionary activity among all the Germanic and Slavic nations of Europe. Gregory sent the Prior Augustine with 40 monks to preach the Gospel to the Anglo-Saxon conquerors of Britain, 596; Ireland sent forth St. Columba to the Hebrides and the Picts of Caledonia, and St. Columban and St. Gall to the Franks and Alemanni on the Continent. The converted Anglo-Saxons, in their turn, gave to their heathen kinsmen east of the Rhine the greatest missionary of the Middle Age: St. BONIFACE, the Apostle of Germany, the reformer and organizer of the Church in the kingdom of the Franks, the man who more than any other prepared the way for Charlemagne and his Empire. Boniface found a martyr's death at the hands of the pagan Frisians, 754.

The Church's gains in the west and north of Europe were offset by terrible losses in the east and south. In 622 (*Hegira*) Mohammed began his career of conquest, which was pushed to the limits of the known world by his successors. Eastern Christianity was decimated; North Africa and Spain were overrun, 711; all Southern Europe was raided. Islam's northward advance was checked by the victory of Charles Martel at Tours, 732; but the losses suffered by the Church through its conquests were great and lasting. Countries which had belonged to her for centuries, in fact the oldest centers of Christianity, Jerusalem, Antioch, Alexandria, Carthage and Seville, were torn from her, and the way to their reconquest seemed barred for all time.

The 8th century witnessed far-reaching changes in Western Europe. The weak Merovingian successors of Clovis were succeeded by the vigorous and ambitious Carolingians. In order to maintain their civil independence against the Lombards, the popes severed their connection with the Byzantine Empire and accepted the temporal power which the force of circumstances and the good-will of the Franks put into their hands, 756. The alliance of the Papacy with the Carolingians led to the restoration of the Roman Empire of the West. Charlemagne was crowned emperor by Pope Leo III on Christmas Day, 800.

The disruption of the Carolingian Empire, brought on by its own internal weakness and the constant raids of the Vikings from the North and the Magyars from the East, led to the introduction of the Feudal System, which so profoundly affected both Church and State during the rest of the Middle Ages. In the 10th century the Papacy became involved in the feudal party strife of Italy and the City of Rome, and was, in consequence, plunged into such an abyss of degradation that it was in danger of losing every

shred of its moral authority over Christendom. It is the darkest period of Church history. The Catholic historian Baronius calls it the Iron Age. The gloom is relieved by the conversion of the Scandinavian and Slavic races and the spread of Christianity into Iceland and Greenland. Better days dawned for the Church when Otto the Great, King of Germany, founded the Holy Roman Empire, 963. His successors, especially Henry III, rescued the Papacy from its humiliating subjection to the Roman barons and, with the aid of the monks of Cluny, energetically took in hand the reform of the Church "in head and members."

The Great Schism. This much-needed work of reform had hardly got under way, when the disastrous schism, known as the Great Schism, broke the unity of Christendom and cut off an appallingly large fragment from the Catholic Church, 1054. All attempts made in later times by Popes, Emperors and Councils to reunite East and West proved futile.

The much-needed work of reform within the Church, begun by the German emperors and the German popes, 1045-1058, was vigorously carried on by Gregory VII, or HILDEBRAND, 1073-1085. His struggle for the liberation of the Church from secular control ended in the establishment of the supremacy of the Papacy over the Empire. The popes were the acknowledged heads of the Christian Commonwealth of Europe, the judges not only in spiritual but also in temporal matters. The 12th and 13th centuries were perhaps the most glorious period of Church History. It was the age of the great Christian schools and scholars, of the military religious orders and the mendicant friars; the age of Romanesque and Gothic art and architecture; the age of the troubadours and the minnesingers; the age of PETER ABELARD, ANSELM, BERNARD OF CLAIRVAUX, ALBERTUS MAGNUS, ST. THOMAS AQUINAS, St. Louis of France and St. ELIZABETH of Hungary; the age of the great mystics, of St. FRANCIS OF ASSISI and St. DOMINIC, St. Gertrude and St. Mechthildis. It was the "age during which the dream of St. Augustine of a Kingdom of God on earth under the rule of the Church was for a time all but realized." Knights and monks placed themselves at the service of the Church and made possible the Crusades, 1096-1272, which gave to Europe "the undying memory of a spiritual romance," though they did not attain their main object: the deliverance of the Holy Land from the infidel and the reunion of the large body of Eastern Schismatics with the Catholic Church.

During the pontificate of Innocent III (*see* INNOCENT), 1198-1216, the Papacy was at the noontide of its power. All Europe was at the great pontiff's feet. The Fourth Lateran Council, which climaxed his reign, was the most brilliant gathering of churchmen since the days of Nicaea. It was at this council that plans were made to rid Southern Europe of the dreaded plague of the New Manichaean or Albigensian heresy (*see* ALBIGENSES), which threatened to overthrow both Church and State. A fruit of the Albigen-

sian wars was the INQUISITION, an institution which no Catholic historian cares to defend unreservedly.

For nearly 100 years after the death of Innocent III the Church maintained her commanding position in Europe, though not without much opposition. The fall of Frederick II, which shattered forever the power of the Holy Roman Empire, freed the Papacy from the Hohenstaufen threat, but forced it to seek an alliance with the French monarchy. Boniface VIII (*see* BONIFACE), 1294-1303, succumbed in the conflict with Philip the Fair. The Papacy lost its temporal supremacy. For 70 years the popes resided far from Rome at Avignon in the shadow of the French throne. The calamity of the Babylonian captivity was accentuated by the terrible ravages of the Black Death, 1348, but in a measure was redeemed by the bold missionary enterprise, sponsored by the Popes of Avignon, in the lands of the Grand Khan of Tartary. The attempt to restore the seat of the Papacy to Rome led to the disastrous Schism of the West, 1378-1417, when two popes, and for a time even three, claimed the allegiance of Christendom. The reunion effected at the Council of Constance was followed by a sharp conflict between Pope and Council. The Papacy triumphed in the Council of Florence, 1439, East and West solemnly acknowledging the Primacy of the Pope.

With Nicholas V, 1447, the first Humanist Pope ascended the throne of the Fisherman. For nearly 100 years the Papacy was identified with the deep and widespread intellectual and artistic movement of the Renaissance, whose destinies it attempted to guide, but only too often fell a prey to its worldly and sensual lure. It was an age of unrest, political, social and religious. The popes, some of them utterly unworthy of their high office, failed to heed the signs of the time which pointed to an approaching religious upheaval.

Protestant Revolt. In the early 16th century the storm which had long been gathering broke with elemental violence. Protestantism appeared. Wittenberg, Geneva and London were its starting points; MARTIN LUTHER, JOHN CALVIN and HENRY VIII were its protagonists. The Bible alone, privately interpreted, was its platform. The absolute corruption of man and the enslavement of his will by Original Sin, Justification by Faith alone, Predestination, State absolutism and supremacy in religious matters, were its dogmas. Protestantism reached its zenith on the Continent in 1555 at the Peace of Augsburg. Of the northern nations Ireland alone resisted the religious innovators.

As soon as the Protestant revolt had spent its force, the Catholic reaction set in. Protestantism was checked in its onward march by the arms of the princes, who had remained faithful to the Church. The Council of Trent, 1542-1563, saved Catholicism. Animated, equipped and organized for the struggle, and led on by energetic and holy popes, bishops, priests, monks and nuns, lay men and women, the Church advanced against the forces of rebellion. The

ascendancy of Catholicism was reestablished in the greater part of Europe. Its losses in the Old World were compensated for by conquests in the newly discovered continents. Hosts of zealous missionaries followed in the wake of the conquistadors in North and South America and extended the empire of the Church to the extremities of the western world.

The Treaty of Westphalia, 1648, guaranteed by Protestant Sweden and Catholic France, secured to Protestantism permanent possessions on the Continent. The Pope protested, but in vain. The Western Church was definitely rent in twain. *Cuius regio, eius religio*, was accepted as a political principle throughout Europe and the European colonies. Royal absolutism, Jansenism, which could never deny its kinship with Calvinism; Gallicanism, which attempted to undermine the primacy, supremacy and infallibility of the popes; Rationalism, which was a reaction against religious intolerance, and which logically ended in religious indifferentism and unbelief, prepared the stage for the tragedy of the French Revolution. It is the saddest and most depressing period of Church history, though it produced, in its earlier years, some of the greatest Christian scholars and sacred orators of all times.

The French Revolution swept over Europe, 1789, leaving ruin in its wake. The Church suffered most. She was despoiled of all her possessions. Her treasures of art were pillaged, her sacred vessels were stolen, her institutions of charity and learning suppressed. The fall of Napoleon, 1815, saw the Church poor, dependent on the State and the generosity of the faithful for her earthly subsistence.

Catholic Revival. During the 19th century the Poor Bride of Christ accomplished what she failed to do whilst arrayed in all the panoply of wealth and power during the 18th; she slowly but steadily won back her empire over the souls of men. In France, in Germany, and then throughout Europe a great Catholic revival took place, which, though interrupted at times, has never ceased to grow. A veritable "second spring" burst upon the British Isles after emancipation had been won, 1829, while in the New World, under the fostering sun of freedom, she grew from a small and tender plant into a mighty tree spreading its branches from coast to coast. In 1870 the Church received what all the world believed to be the death blow to her temporal power and, in consequence, to her world prestige. But since then she has stood before the world as the greatest of moral powers, resting on the consciences and the hearts of her children.

By the Lateran Treaty, Feb. 11, 1929, the Vatican was transformed into a sovereign State with a territory of about 160 acres and approximately 300 inhabitants. The Vatican State was restricted to this small area at the express wish of Pope Pius XI, "in order to manifest to the world," as he said, "that the object in acquiring territory was to safeguard the independence of the Holy See, and not the attainment of political power and kingly splendor." The

new Papal State is the smallest, but at the same time the greatest of European States. The Pope is the temporal sovereign over a few hundred employees of the Vatican and their families, but the spiritual ruler of 200,000,000 Europeans, of the hearts of two-thirds of the inhabitants of Europe, and of more than 100,000,000 in the rest of the world.

The future of the Catholic Church in the United States of America, whose advance by leaps and bounds from a membership of less than 25,000 at the time of the War of Independence to more than 20,000,000 in 1931 is an outstanding phenomenon in Church history, is assured. Every Catholic feels that the Catholic Church is in accord with American liberty, and as one of her historians remarks, "the strongest power for the preservation of the Republic from the new social dangers that threaten the United States as well as the whole civilized world. She has not grown, she cannot grow, so weak and old that she may not maintain what she has produced—Christian civilization."

J. J. L.

BIBLIOGRAPHY—H. Belloc, *Europe and the Faith*; B. Conway, *Studies in Church History*, F. X. Funk, *Manual of Church History*, H. Grisar, *History of Rome and the Popes*, P. Guilday, *Introduction to Church History*, G. Kurth, *The Church at the Turning Points of History*, J. Laux, *Church History*; H. Mann, *Lives of the Popes*, J. MacCaffrey, *History of the Catholic Church from the Renaissance to the French Revolution* (2 vols.), *History of the Catholic Church in the Nineteenth Century* (2 vols.), T. O'Gorman, *The Church in the United States*; L. Pastor, *History of the Popes*, G. Stebbing, *The Story of the Catholic Church*, P. Batiffol, *Primitive Catholicism*; L. Duchesne, *The Churches Separated from Rome*, A. D. Sertillanges, *The Church*.

ROMANCE, originally the name given to any composition, whether verse or prose, in a Romance language; used in the 12th, 13th and 14th centuries to designate a certain type of heroic narrative written in Early English or Old French, and in the 15th and 16th centuries to designate a fanciful story of knightly adventures. In the modern sense, romance is a term applied to any piece of writing which, concerning itself predominantly with the adventurous and the marvelous, is deliberately removed in subject-matter and style from the common aspects of life, having marked tendencies to idealize all situations and to exaggerate all human qualities. Ancient examples of the romance (the romantic elements in the Homeric epics, especially in the *Odyssey*, should be noted) are afforded by such Greek and Latin works as Longus's *Daphnis and Chloe*, Musaeus' *Hero and Leander*, Apuleius's *GOLDEN ASS*, etc. The earlier medieval romance is well illustrated by such works as Benoît de Sainte-More's *Roman de Troie* (12th century), and the *ARTHURIAN LEGENDS*. Typical romances of knightly adventure are *Morte d'Arthur*, 1485, and *Amadis of Gaul*, 1508. Splendid modern romances have been written by Hugo, Dumas père, Scott, Cooper, Stevenson and others. See also *ROMANTICISM*; *NOVEL*.

ROMANCE LANGUAGES, a group of languages, consisting of French, Italian, Sardinian, Spanish, Portuguese and Galician, Provençal and

Catalan, Rhaetian, Rumanian, and the almost extinct Dalmatian, derived from Vulgar Latin, and spoken by some 175,000,000 persons, chiefly in Europe and the Americas. (See separate articles on these languages.) The term is derived from medieval Latin, in which *Romanice loqui* meant "to speak Romance," the *lingua Romana rustica*, the vulgar tongue consciously and officially distinguished from Latin, the *lingua Romana* proper, at the Council of Tours in 813. It first designated French, then Spanish as well, and finally was extended by Dietz and the nineteenth-century linguists to all the modern languages evolved from Latin. H. F. M.

BIBLIOGRAPHY—G. Grober, *Grundriss der romanischen Philologie*, 2nd ed., vol. 1, 1904, E. Bourciez, *Éléments de la linguistique romane*, 3rd ed., 1930, W. Meyer-Lubke, *Grammaire des langues romanes*, 4 vols., 1890-1906, and *Einführung in das Studium der romanischen Sprachwissenschaft*, 3rd ed., 1920, A. Zauner, *Romanische Sprachwissenschaft*, 2 vols., 4th ed., 1921-26.

ROMANCE OF THE ROSE (*Roman de la Rose*), a 13th century French poetical allegory in two unequal parts, begun by Guillaume de Lorris and continued by JEAN DE MEUN. The first part, comprising some 4,670 lines, is sheer allegorical romance, as opposed to the political satire of the second part, which is in nearly 20,000 lines. In the first, the hero Amant enters an enchanted garden one spring day and there, after numerous adventures with nymphs, falls in love with the Rose, in which love he is aided by Welcome, until Jealousy shuts Welcome into a high tower and encircles the Rose with a wall. In the latter part the hero, after many erudite debates with Reason and Nature on the divine right of kings, the morality of the clergy and other timely subjects, is at last permitted to pluck the Rose. The influence of the *Roman*, particularly on CHAUCER and Gower in English, was greater perhaps than that of any other medieval work.

BIBLIOGRAPHY.—E. Langlois, *Origines et sources du Roman de la rose*, 1891; trans. by F. S. Ellis, 1900; D. S. Fansler, *Chaucer and the Roman de la Rose*, 1914.

ROMAN CONSTITUTION, THE, which was unwritten, was subject to continual modification. The government as organized in the middle of the 1st century B.C., the time of Cicero, Pompey and Caesar, before the latter by his autocratic measures had destroyed its republican character, has the greatest interest for modern students. The officials who regularly administered the government were: two consuls, eight praetors, two censors, 10 tribunes, four aediles, and 20 quaestors. The tenure of all these officials was limited to one year, excepting the censors whose duties made a somewhat longer term expedient. Every office was shared by two or more holders, each of whom might veto any proposal or block any action of his colleague or colleagues.

To prevent undue obstruction resulting from this general veto power a division of duties was frequently made between the several holders of each office. The relative importance and dignity of the various offices were clearly defined, and a regular mode of progres-

sion from the lower to the higher was recognized. The principal duties of the consuls were to preside over the Senate, to propose bills for its consideration, to present the names of the candidates to the people assembled for the election of magistrates, and to conduct military operations. Although the consuls might initiate legislation in the popular assembly, the tribunes more frequently did so. The tribunes, the traditional champions of the people's rights, were peculiarly venerated, and by their unlimited veto power they could block the action of any magistrate whatsoever. The praetors presided over the civil and criminal courts. The censors took the census, classifying the citizens in accordance with their wealth and even their moral worth. The aediles supervised the police, public entertainments, streets, baths, temples and the like. The quaestors were receiving agents and paymasters of public funds. Most of them were assigned to duty in the Roman provinces as assistants to the provincial governors. The governors were ex-consuls or ex-praetors, technically known as proconsuls or propraetors, whose power during their term of office was almost unlimited, but who on their return to Rome were held accountable for their conduct.

The senate was composed of 600 members, all of them ex-magistrates. It met only when convoked by a magistrate, who also determined the order of business and alone might initiate legislation. Its advice, however, was constantly sought by the magistrates who wished to profit by the administrative experience and political wisdom of its members and to enlist the senate's support in their multifarious activities. The senate exercised general supervision over religion, finance and foreign affairs. The formal ratification of treaties and the declaration of offensive war were, however, reserved for the popular assembly, or *comitia centuriata*. This assembly of the whole people also met to elect the higher magistrates and to hear appeals in cases involving the death penalty. Another popular assembly of different origin and composition, the *concilium plebis*, under the presidency of the tribunes had complete legislative competence. The tribunes averted conflicts between this assembly and the senate by constant consultation with the latter.

G. M. H.

BIBLIOGRAPHY.—T. Mommsen, *History of Rome*, trans. by W. P. Dickson, 1894; F. F. Abbott, *Roman Political Institutions*, 1901, 1907, 1911; G. W. Botsford, *The Roman Assemblies*, 1909.

ROMAN DRAMA. In 240 B.C. Lucius Livius Andronicus, a Greek by birth, produced Latin translations of a Greek tragedy and a Greek comedy. After that tragedies and comedies were regularly performed at Roman festivals. Most of them were Latin translations of Greek plays, though some tragedies (*fabulae praetextae*) and some comedies (*fabulae togatae*) were Roman in subject, costume and setting. This continued for about 150 years, after which tragedies ceased to be performed. The nine elaborate tragedies of Seneca (c. 1-65 A.D.) are literary productions rather than dramas intended for the stage. Of other Roman

tragedies almost nothing is preserved. The 20 complete comedies, with extensive fragments of another, by TITUS MACCIUS PLAUTUS (c. 254-224 B.C.) and the six by Publius Terentius Afer (c. 190-159 B.C.), called



SCENE FROM A TRAGEDY OF THE ROMAN PERIOD
From the relief on the grave monument of P. Numitorius Hilarus,
about 25 B.C.

TERENCE in English, are *fabulae Palliatae*, Greek comedies in Latin. They are all derived from Greek originals of New Comedy except the *Amphitruo* of Plautus, which belongs to Middle Comedy. Plautus did not always adhere closely to his original; he introduced Latin puns and various Roman allusions in his comedies. His language is that of ordinary Romans, and his wit is sometimes coarse. Terence, although he shows some originality, tries to reproduce in Latin the refinement and charm of his Greek originals.

Some less literary dramatic entertainments were popular in Rome at certain times. The Fescennine Verses (*versus fescennini*), originally rude improvised responses, were full of jokes and personalities which became so violent that the performances were forbidden. An improved form of Fescennine Verses, called *satura*, hardly survived the introduction of GREEK DRAMA. The *fabulae Atellanae* were short pieces with conventional characters—fool, braggart, old man, liar and the like. They were introduced at Rome in 211 B.C. and continued to be performed for several centuries. The mime, introduced from the Greek cities of Sicily and southern Italy, was a farce combined with dancing. Some of the actors and dancers were women. The humor was coarse and the plots often indecent. Under the Empire the Pantomime was popular. This was performed by an actor, or dancer, accompanied by a singing chorus and an orchestra. He represented by motions and gestures the persons and acts about which the chorus sang. His acting was more important than the words.

The Roman theater was built on level ground, and its ascending rows of seats were supported on masonry. The stage was four or five feet high and wide

enough to accommodate all the actors, chorus and supernumeraries. Behind this was a building two or three stories high which served as a background. In front of the stage was the semicircular *arena*, where distinguished persons sat. From this rose the semicircular auditorium (*cavea*), at the top of which was often a covered gallery. An awning protected the audience from the weather. Some small theaters had roofs. The earliest permanent theater in Rome was built by Pompey in 55 B.C. The Roman theater had a curtain and various contrivances for indicating changes of scene. The chorus was of little importance, but the comic actors sang portions (*cantica*) of their text. Dramas were divided by choral interludes into five acts. Costumes were in general like those used by the Greeks, though the *fabulae praetextae*, *fabulae togatae* and *fabulae Atellanae* employed native costumes. Masks were not worn in comedy for about a century after its introduction, but were worn in tragedy, in the *fabulae Atellanae* and in the mime.

H. N. F.

BIBLIOGRAPHY—W. W. Fowler, *Roman Festivals of the Period of the Republic*, 1901; L. Friedlander, *Roman Life and Manners under the Early Empire*, 1908-13; J. T. Allen, *Stage Antiquities of the Greeks and Romans and their Influence*, 1927.

ROMANESQUE ARCHITECTURE, the architecture of Europe outside of the Byzantine Empire from the extinction of Roman culture up to the time of the development of **GOthic ARCHITECTURE**, which occurred during the century 1150 to 1250. Certain authorities restrict the work to the period after the death of Charlemagne, dividing the earlier work into Merovingian and Carolingian, Lombard, and other architectures; but the broader definition is simpler and also expresses a real unity of aims and methods. Romanesque architecture was developed in the attempt to build masonry churches and monastic buildings decorated with ornament symbolic and expressive of the builders' cultures, with ideas borrowed alike from Byzantine and earlier imperial Roman architecture.

The newer races, largely Teutonic, with a background colored by the forests of the north and a mythology romantic, dreamy and at times savage, who filtered into the Roman Empire in successive waves in the 4th, 5th and 6th centuries, could not remain insensitive to the superb Roman buildings around them. As they settled in their new homes, intermarried with the Roman and Celtic inhabitants, and became officially Christianized, a new culture was born and sought architectural expression. The beginnings of the new style can be traced as early as the 5th century in Ravenna, the capital of the Western Empire from 403-476, and of the Gothic kingdom, 476-530. Here, on the walls of San Giovanni Evangelista, 425, arcaded cornices and decorative wall arcades already occurred; in San Pier Crisologo, 433-449, this type of decoration was further developed. With the conquest of the Lombards, however, this early beginning was overwhelmed.

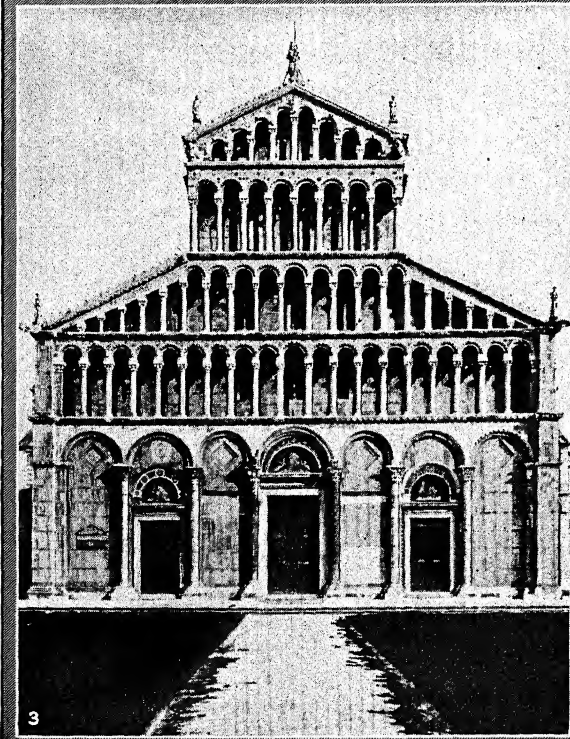
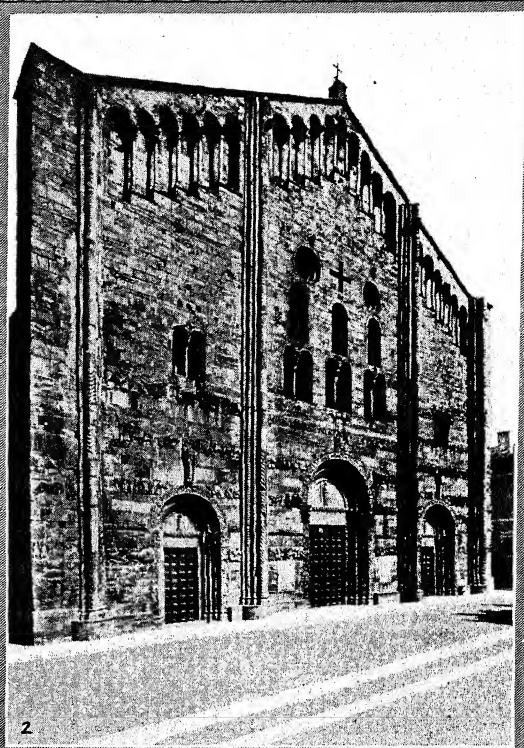
The Dark Ages produced little important architecture that still stands. In the 8th century, the Lom-

bard kings officially recognized a builders' guild, the Comacini, who seem to have preserved some of the earlier building traditions. The Abbey Church at Agliate, 9th century, the old house at Ascoli Piceno, known as the Casa Lombarda, 8th or 9th century, the 9th century choir of San Pietro at Toscanella, and the so-called Palace of Theodoric in Ravenna, 8th century, all reveal crudity of construction and poverty of decoration. But they also indicate a genuine attempt to solve the structural problems in a new way fitted to the crude technique, and to create an ornament that already showed the vivid grotesque character so intimately associated with later Romanesque work, a distinctly northern, non-Roman and non-Byzantine element. Meanwhile, in Gaul and on the Rhine buildings were crude imitations of Roman work, as in the baptistry of St Jean at Poitiers, 676-696, or the famous gate of the Abbey Church at Lorch, late 8th century. And when Charlemagne attempted to build at Aachen the most beautiful church in Europe, late 8th and early 9th century, he was compelled to turn to the Byzantine work of Ravenna for inspiration.

The enormous growth of monasticism, and the beginnings of settled town and city life, gave rise to a new architectural vitality from the middle of the 10th century on, and especially after the year 1000. Moreover, certain changes in ecclesiastical usage had occurred to give new problems. These were the development of the crypt, or underchurch; the use of bell towers, and the consequent development of tower design; and the growing popularity of many chapels and a procession path around the sanctuary, which led to the development of the French **CHEVET**, or apse, with ambulatory around, from which radiating chapels opened. The reasons for the development of the chevets are obscure. The need in Monastic churches of many altars for the daily masses of the numerous clergy, and in the later period the adoration of relics and the development of the pilgrimage spirit, both aided this growth. The tremendous loss from fires in the earlier wooden roofed basilicas made it more and more necessary to make churches as nearly fireproof as possible by vaulting them. Later in the period, the development of **STAINED GLASS** made windows larger and further modified church requirements.

The 11th century was accordingly a great period of experiment all over Europe in the search for ways to build a monastic church with nave and aisles for the laity, transepts, choir and chancel for the priests and choir, an ambulatory or procession path, and many small chapels; the whole to be well lighted, stone vaulted throughout and lavishly decorated. In this experimentation, the influence of the widespread monastic orders was tremendous. They were the great builders of the time and the centers of building skill. The protest of St. Bernard of Clairvaux (1090-1153) against the lavish grotesque ornament of his time led the Cistercian order to a creative attack on larger and simpler architectural problems. The round, square or polygonal type of church, going back to Roman and Byzantine domed precedents, still con-

ROMANESQUE ARCHITECTURE



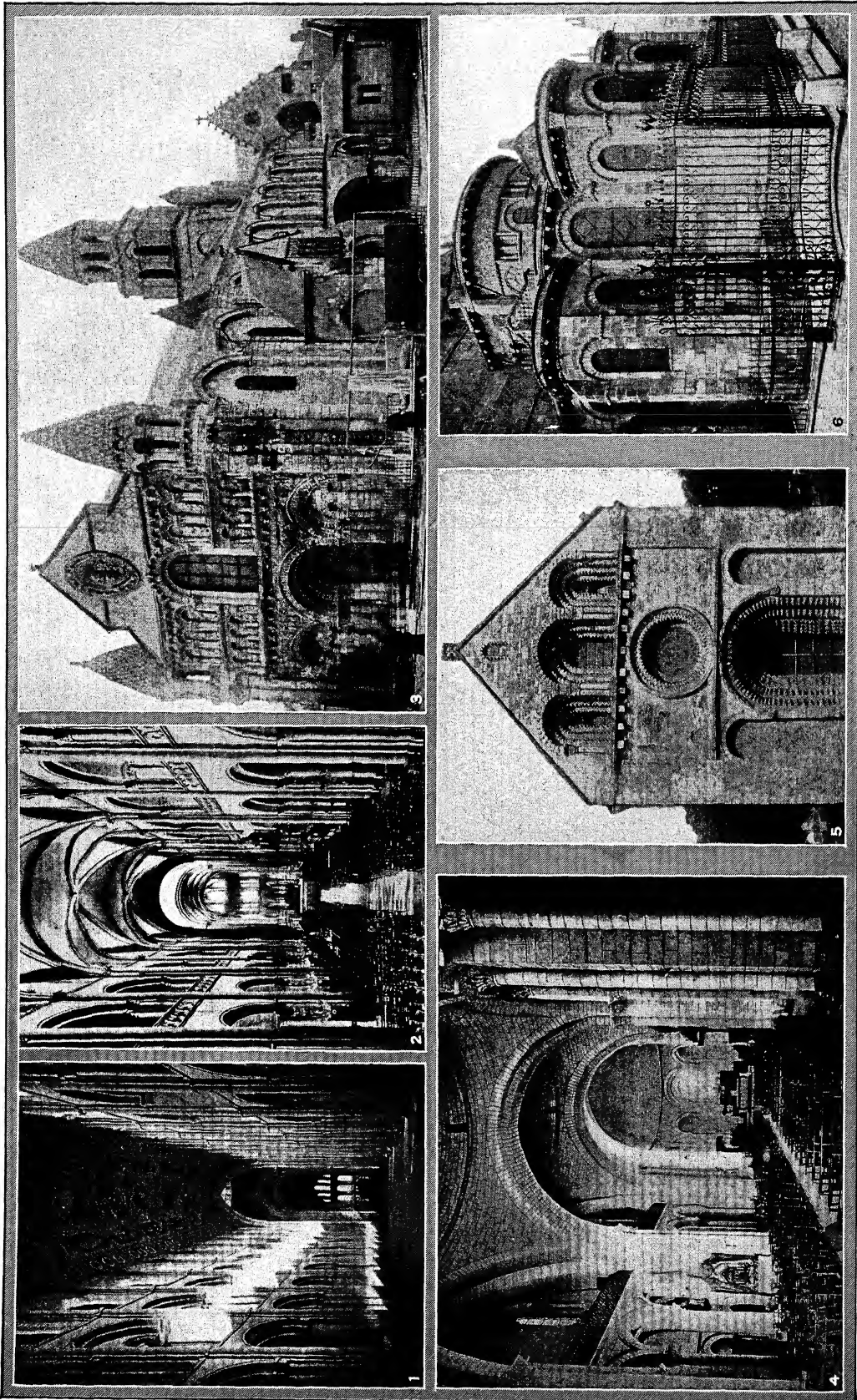
4. COURTESY GERMAN RAILROADS INFORMATION OFFICE, NEW YORK

ROMANESQUE CHURCH ARCHITECTURE IN ITALY AND GERMANY

1. Interior of the basilica of Sant' Ambrogio, Milan, Italy. 8th-10th centuries. 2. Lombard-Romanesque basilica of San Michele, Pavia, Italy. 11th-12th centuries. The façade is decorated with reliefs in sandstone, in ribbon-like stripes.

3. Tuscan-Romanesque Cathedral of Pisa, Italy. 11th century. 4. Apostles' Church, Cologne, Germany, a Rhenish-Romanesque structure begun in the 11th, but largely rebuilt in the 12th century.

ROMANESQUE ARCHITECTURE

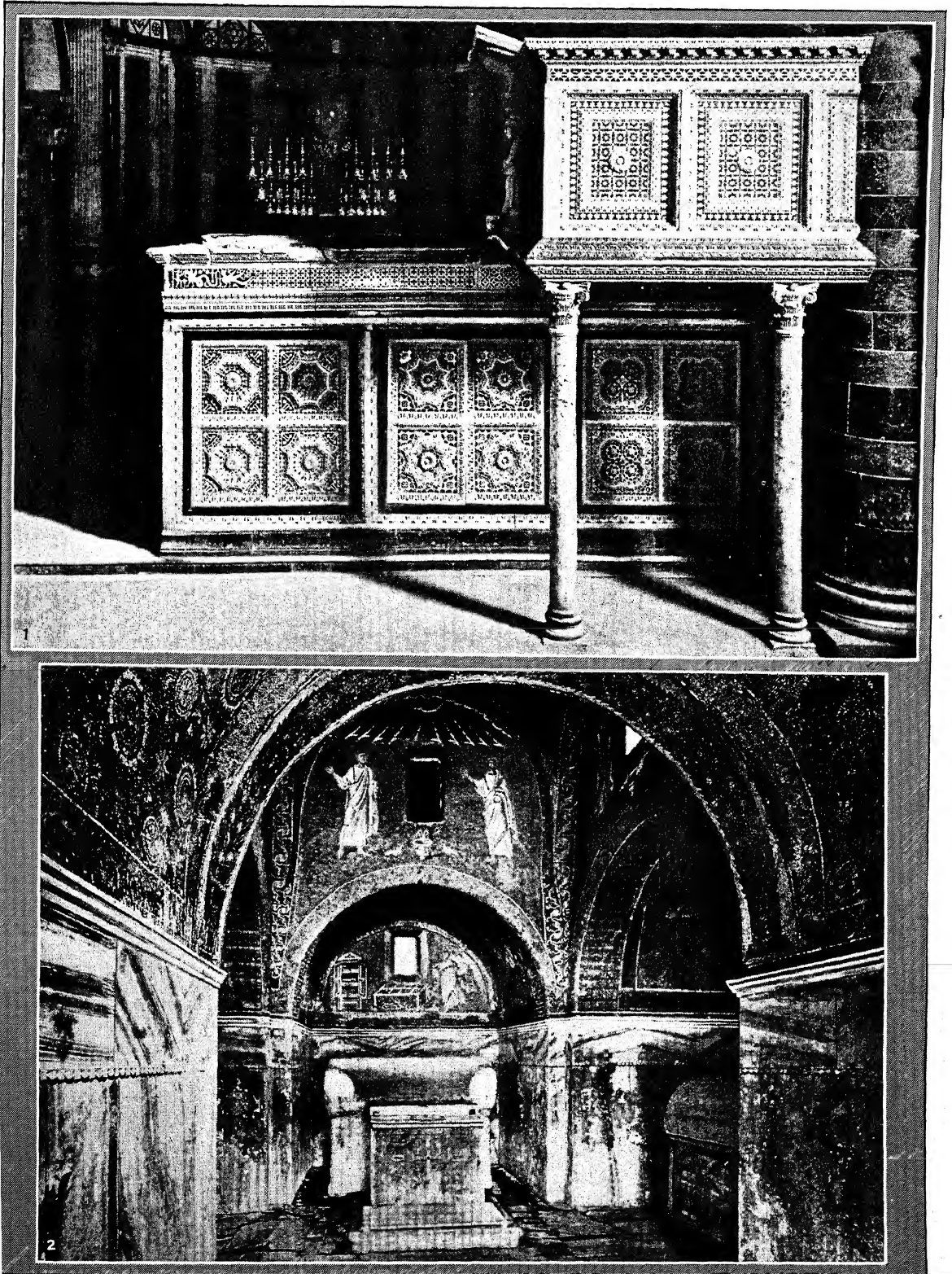


3, COURTESY RAILWAYS OF FRANCE

ROMANESQUE CHURCH ARCHITECTURE IN ENGLAND AND FRANCE

1. Nave of the Cathedral of Ely, England. 11th-12th centuries.
2. Nave of the Church of St. Étienne, Caen, France. 11th-12th centuries.
3. Notre Dame la Grande, Poitiers, France. Late 11th century.
4. Nave of the Cathedral of St. Pierre, Angoulême, France. 11th-12th centuries.
5. Norman church of Iffly, England. 11th-12th centuries.
6. East end of Notre Dame du Port, Clermont-Ferrand, France. 11th-12th centuries.

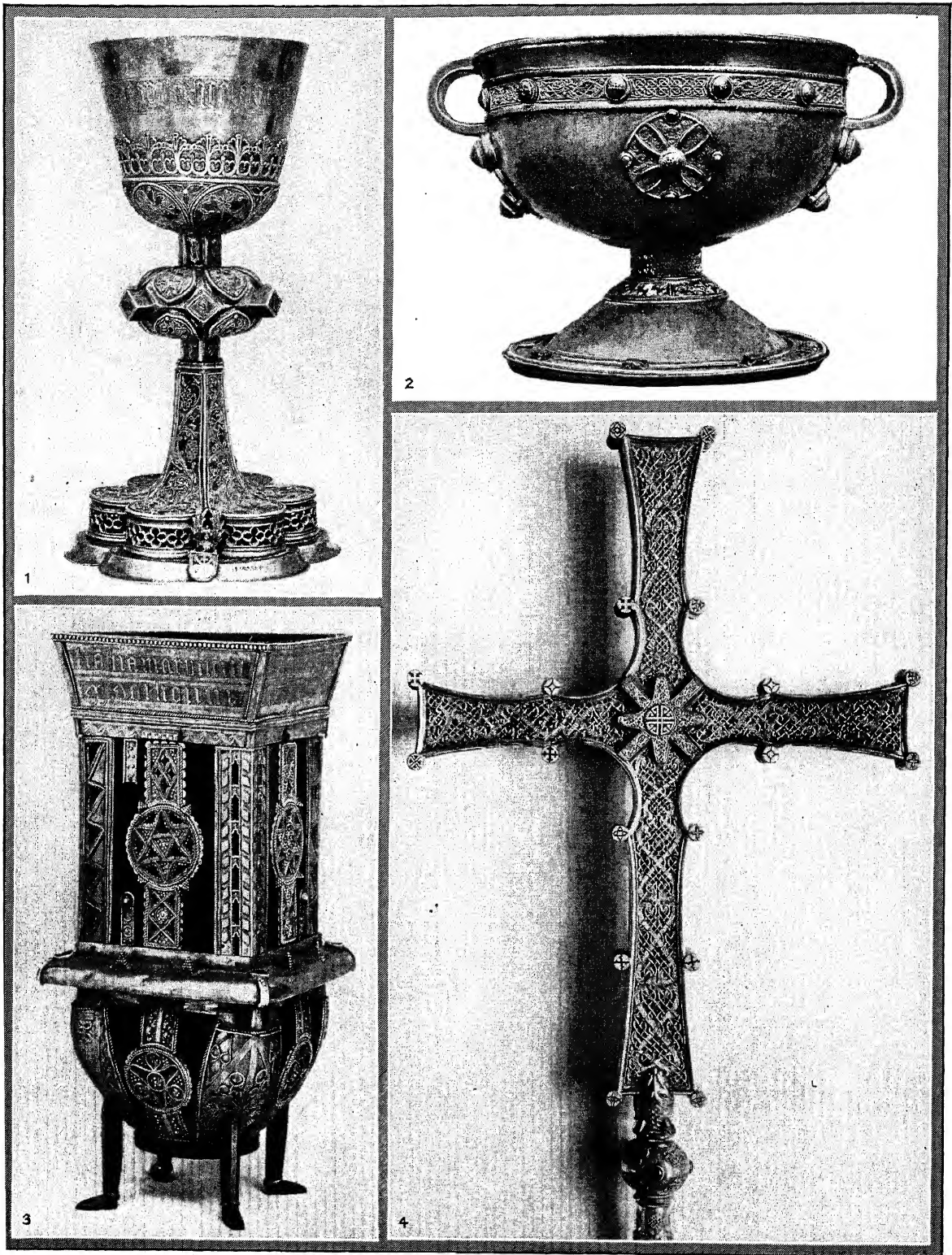
ROMANESQUE ARCHITECTURE



ART OF ROMANESQUE STYLE

1. Church of San Miniato al Monte, Florence, Italy, dating from the 11th century, showing pulpit of marble inlay.
2. Mausoleum of Galla Placidia, Ravenna, Italy, built about 440. The dome and barrel-vaulting are lined with mosaics.

ROMANESQUE ART



3, 4. COURTESY METROPOLITAN MUSEUM OF ART

EXAMPLES OF ROMANESQUE METAL WORK

1. Chalice of silver gilt enamel, late 15th century.
2. The Ardagh chalice of Ireland.
3. The Dunvegan cup, dated 993.
4. Cross of Cong, 1123, made of oak set with plates of copper, covered with gold and silver and set with stones.

tinued in occasional use, however, especially in Italy and south France.

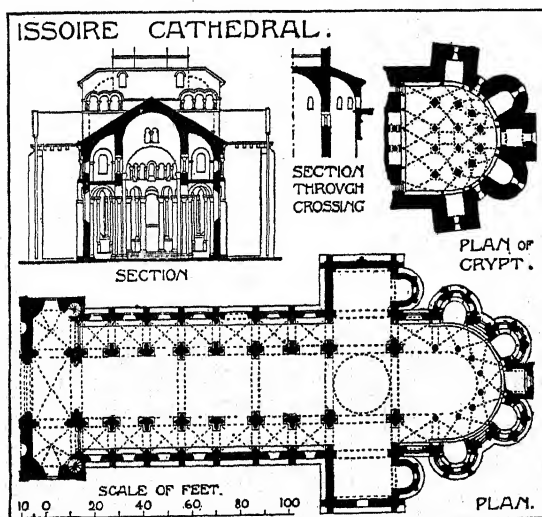
Romanesque Vault Types. The great difficulty in supporting stone vaults is the problem of withstanding their thrust or tendency to spread out and collapse. Early Romanesque buildings had tremendously thick walls to take the thrusts; later, the pilaster strip used decoratively in Ravenna in the 5th century became a buttress strip and finally a real buttress. The side aisle vaults could be thus buttressed, but the high nave vault was a more difficult matter. The side aisles could be simply covered with groined or intersecting vaults, but early naves usually had a continuous barrel vault. Nave walls and pier arches, or the arches between the nave and aisles, were made very thick, and the nave vault kept as low as possible. Notre Dame la Grande at Poitiers, 11th to 12th centuries, is typical. In this case there was no triforium or clerestory; the side aisle vaults themselves buttressed the nave vault. This type of church is known as a Hall Church and is particularly characteristic of Central and Western France, and later in the Gothic period of Germany. Examples are Silvacanne, 12th century; Aulnay, 1135; St. Savin-sur-Gartempe, 11th to 12th centuries, and Preuilly, early 12th century.

The desire for high naves led to a second type, that in which there was a gallery or triforium over the side aisles, vaulted either with a barrel vault or with a half-barrel vault which buttressed the nave vault. This type is characteristic of Auvergne, as in Notre Dame du Port, Clermont Ferrand, about 1080, St. Paul, Issoire, about 1100, and Conques, 1035. St.

enough to withstand the vault thrust, and to use tiny clerestory windows below the level of the vault spring. This was the method adopted in many 12th century churches of Burgundy, such as St. Lazare at Autun, 1130; Paray-le-Monial, La Charité-sur-Loire, and the great 3rd church of the monastery at Cluny, consecrated 1103, and in the choir of St. Benoit sur Loire, begun in 1071. In these examples the triforium gallery became merely a range of arcades on the nave wall, occupying the height required for the side aisle roofs, as in later Gothic work.

To enlarge the clerestory windows required a different system. In St. Philibert at Tournus, the nave, completed by 1019, was built with a series of barrel vaults running across the church, and supported by great cross arches at each pillar. This allowed large windows and floods of light, but prevented any sense of unity. The answer was the cross, groined, or intersecting vault, long before used by the Romans in the great halls of the baths. (See ROMAN ARCHITECTURE; BATHS.) The development of this type of vault can be traced particularly to the developed Romanesque architecture of Lombardy. Later, in France, Burgundy and Normandy carried the method further.

A perfect groined vault demands a square plan. With a nave approximately twice as wide as the aisles, the simplest solution was to make one bay of the nave equal to two of the aisles. This was done as early as the 10th century, in planning San Ambrogio

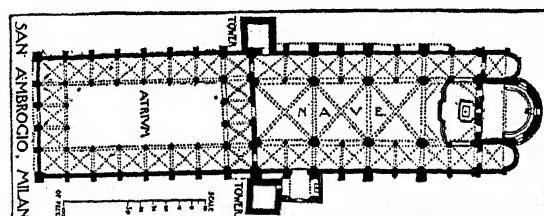


FROM F. M. SIMPSON, A HISTORY OF ARCHITECTURAL DEVELOPMENT. LONGMANS, GREEN & CO.

PLAN AND SECTION OF CHURCH OF ST. PAUL, ISSOIRE, FRANCE

Sernin, Toulouse, with double side aisles and a highly developed chevet, is an unusually large example, though outside of Auvergne.

The adequate lighting of a high nave demanded clerestory windows over the side aisle roofs. The easiest manner was to make the nave walls thick



FROM F. M. SIMPSON, A HISTORY OF ARCHITECTURAL DEVELOPMENT. LONGMANS, GREEN & CO.

in Milan, thus bringing the weight of the nave vaults upon alternate piers only. These were made larger, to take the heavier weight, and this alternation of light and heavy piers became characteristic of Lombard work, and is found also in much French work, as in the Church of St. Dié, Vosges, or the nave of Le Mans Cathedral, 1093. Moreover, the Lombard builders discovered that it was much easier to build a vault divided into small sections by ribs, or arches, and in the 11th century vault of San Ambrogio this system was already used. In addition to the arches connecting the piers across the nave, there were also diagonal arches under the groins, and wall arches connecting the piers on the same side of the nave. This system of vaulting was brought into Normandy by Lanfranc of Pavia, and in the churches of the Abbaye aux Hommes and the Abbaye aux Dames in Caen, both begun about 1066, reached a point of development that made the development of the Gothic vault a certainty. The Norman Cathedral of Durham, built under the same influences, had also a noteworthy ribbed groined vault dating from the end of

the 11th century. Romanesque churches of the Rhine country as well were strongly under Lombard influence. The examples at Worms, begun in 1016 and rebuilt 1116-71; Mainz, 1037-1106; Cologne, Holy Apostles 1160-99; and St. Mary in the capital, begun in the 9th century and vaulted in the 12th, are noteworthy. Yet the French seldom accepted the Lombard scheme whole-heartedly or entirely; they were searching for a more unified effect than that produces. The result worked out in the 12th century in the Ile de France and Normandy was the **SIX PART VAULT**, in which in addition to the diagonal groin arches, wall arches and cross arches at the alternate piers, an additional cross arch in the center was used, and the nave wall arches thus brought into scale with the side aisle bays. An awkward transitional approach to this scheme is found in the Abbaye aux Dames at Caen. The fully developed type was used in the Abbaye aux Hommes, also at Caen. The six part vault became common in the early Gothic period.

The use of the groined vault concentrated the thrust of the nave vault at the piers, and the old system of continuous abutment by means of heavy walls and vaults over the side aisle galleries no longer sufficed. The answer was found in the **FLYING BUTTRESS**, an

churches, the final solution belongs to the history of Gothic architecture

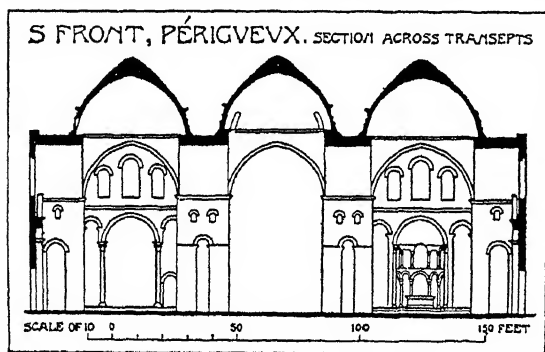
Byzantine influences in southern, central and western France gave rise to an entirely differing vault system based on the dome on pendentives and the octagonal dome whose diagonal faces were carried on little arches or niches known as squinches. St. Front at Périgueux, 1120, follows in plan and structure the almost contemporary St. Mark's in Venice. (See **BYZANTINE ARCHITECTURE**.) In Aquitaine, the same general structural system was applied to long, basilican churches, all of the 12th century, such as Cahors Cathedral, with two domes; Angoulême Cathedral, 1101-28, with a cross-shaped plan; Solignac church, 1143, choir 1178-1211, and Souillac. The variant with octagonal domes can be seen in St. Hilaire at Poitiers, about 1130, and in the magnificent Cathedral of Le Puy en Velay, 1100-50.

The Pier and Arch. Romanesque construction demanded heavy walls and, naturally, thick arches and large piers to support them. In the effort to reduce the weight and the harsh crudity of effect thus produced, arches were early stepped in section as in San Pietro, Toscanella, 9th-11th centuries, or molded as in San Pietro at Asti, 11th century. With the introduction of cross ribs in a vault, it became natural to break up the plan of the piers, by applying engaged columns to them, or making them cross-shaped, one member carrying each pier arch, one member carrying the cross rib of the side aisle vault, and one carrying up the inside of the nave wall to carry the cross rib of the nave vault.

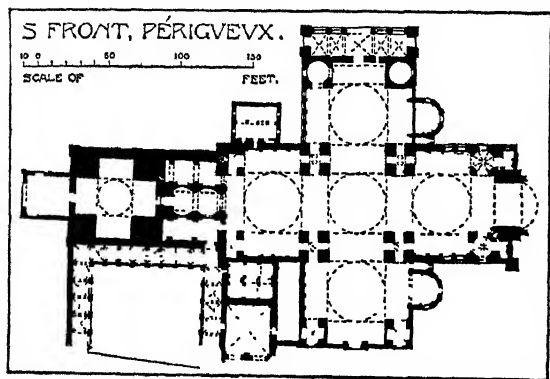
As vault ribs and arches grew more complex, additional pier members were added to recall the principal elements of the moldings above and the additional ribs. The clustered piers resulting not only gave interest and apparent lightness to the whole, but had a basic logic in their appearance, and are characteristic of much Romanesque work alike in Italy, Spain, Germany, France and England. However, in some Norman work in England, and much early Italian work, the cylindrical column was used, and it was almost universal in Romanesque apses.

Romanesque Decoration. Romanesque ornament expresses its triple origin. Carved capitals are either variants of the Roman Corinthian type, basket-like lacy interlaces of Byzantine origin, though with rounded instead of angular elements, or they are decorated with the grotesques expressive of the north, such as figure sculpture or grotesques of animals, real and imaginary, and foliage. Some have all three elements. Other, uncarved capitals, the so-called cushion type, are cut out of cubical or polygonal blocks with the corners rounded or scalloped, and are particularly common in north Italy, Germany, Normandy and England.

Cornices are usually derivatives of the Corinthian cornice, with grotesque corbels taking the place of the Roman modillions. Profiles became rounded and soft, and there was much carving of repeated leaves and flowers. In Norman work in France and England



FROM F. M. SIMPSON A HISTORY OF ARCHITECTURAL DEVELOPMENT.
LONGMANS GREEN & CO



FROM F. M. SIMPSON A HISTORY OF ARCHITECTURAL DEVELOPMENT.
LONGMANS GREEN & CO.

PLANS OF THE CHURCH OF ST. FRONT, PÉRIGUEUX, FRANCE

arched strut across and above the side aisle to carry the nave thrust over to exterior buttresses. Although tentative examples, usually concealed under roofs, are found in the porch of Vézelay and in the Caen

zig-zags were common, as well as other abstract geometric forms. Rows of conventionalized birds' heads were used, and, on flat bands, rows of projecting hemispheres or pyramids (jewels) or of slightly projecting coin-like cylinders (besants).



ROMANESQUE ANIMAL MEDALLION PANEL

Detail of the series that traverses nearly the whole exterior of the Baptistery at Parma, Italy

In the dark ages, carving was of the simplest and crudest kind, consisting of hardly more than scratches on the stone surface, or the mere cutting away of a background, leaving figures and ornament in flat relief. Certain Italian work of the 8th century, showing Byzantine influence, was better, but it was hardly before the 11th century that Romanesque carved ornament was developed; from then on its rise was swift. The interlace, borrowed from Byzantine ornament, was given new forms, as in the door of San Ambrogio, Milan; the Roman running acanthus scroll was simplified and softened, and used to carry symbols as in the

side doors of San Michele, Pavia, and the door of Avallon in France. In the 12th century, in both Burgundy and Provence, there was a great return to Roman inspiration. Much ornament from the portals of St. Trophime at Arles, and in La Charité sur Loire and Autun is purely classic.

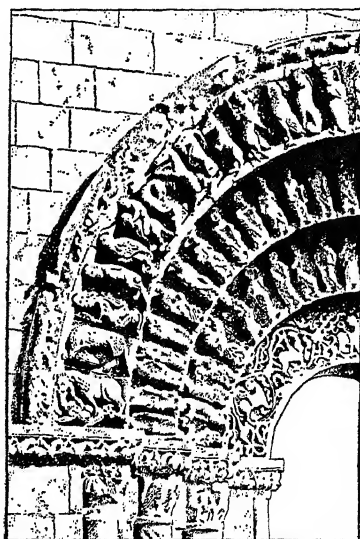
The most characteristic feature of Romanesque ornament is the grotesque. This imaginative ornamental and architectural use of animal forms occurred in Hittite and Etruscan work. It seems to be a product of a people with wild, savage and forested backgrounds. The Barbarian settlers in the Roman provinces found it a peculiarly



COLUMNS SUPPORTED BY LIONS AND DWARFS AT THE ENTRANCE TO THE CRYPT, MODENA CATHEDRAL

congenial medium. Sometimes grotesques are light, amusing; sometimes terrifying, instinct with some nightmare fear. In Lombardy, porch columns are carried on the backs of animals, who have a human figure at their mercy under their feet. This savagery was taken over in reliefs purely religious or symbolic;

devils; last judgments with hell as a gaping dragon's mouth, are common and carved with a painful intensity. Yet the skill with which these strange dreams were presented in the 12th century was superb.



ROMANESQUE ORNAMENTAL RELIEF

Detail of the south portal of the church of Aulnay de Saintonge, France

The outer ring of figures of the South Transept door at Aulnay is as brilliant as it is bizarre and horrible.

Romanesque Portals. Romanesque walls were usually so thick that a simple arched door would appear tunnel-like. The builders therefore developed the scheme of building the arch in steps, or breaks, each one wider than the one behind, so that a small door could be made into a large architectural composition. Furthermore, each step could be molded or carved. Little columns, or nook shafts, could be placed in the reentrant angles. Except in Tuscany, where the persistence of Roman traditions led to other, more classic treatments, this tendency towards enriching the portals was universal.

In the developed portals, the door was rectangular, which allowed a semicircle of stone, the tympanum, over the door and under the arch; on it was placed the most important figure or scene. Christ enthroned, as at Moissac; the Crucifixion, as at St. Gilles; the Virgin, as in the Romanesque door of Bourges; and the Last Judgment, as in Vézelay, Conques, Beaulieu and Autun, were common subjects. The growing skill of the Romanesque sculptors led to a greater and greater use of figures in decoration. With the superb doors of St. Denis, about 1144, of Sant' Iago at Compostella, 12th century, and of Chartres, 1135, not only were the figures themselves beautiful and moving alike in conception and execution, but also a perfect blend of sculpture and architecture was achieved which even the Gothic designers never surpassed.

Civil and Domestic Architecture. The rise of settled town life in the 12th century was accompanied

by a great increase in the number and complexity of town dwellings. Earlier cities had probably been squalid, poor and built largely of wood; but many examples of 12th century houses remain in Spain and Southern France, and reveal a high level of comfort



DOORWAY OF THE CATHEDRAL, ELY, ENGLAND

and even luxury. The houses were usually built between party walls, and shops on the ground floor were frequent. Stairs were often placed in the court or yard at the back, and the one or two rooms of each floor were lighted by grouped round-headed windows.

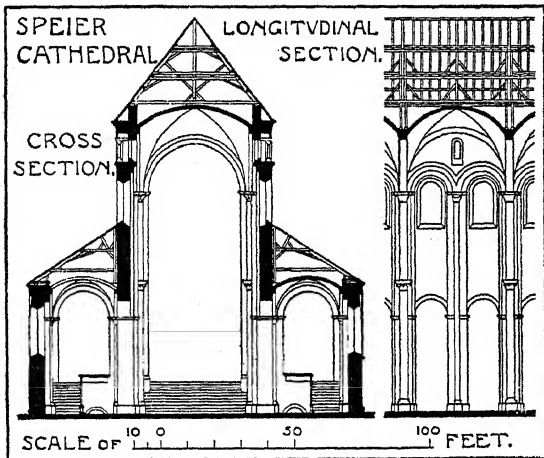
The feudal system kept the country dwellers, except the feudal lords themselves, poor and primitive; their houses were hardly more than huts. Even the feudal castles themselves, although enormous structures in bulk, and often beautifully constructed, were designed primarily for defense, and the residence portions were either simple timber structures within the enclosing walls, or incorporated in the thick walls of the castle itself. The requirements were a guard room, a great hall, or combined living- and dining-room for the lord and his retinue, a chapel, and sometimes one or more bedrooms. Often the great hall was used for sleeping as well as eating. There are interesting remains of Romanesque palaces in Münzenberg, Gelnhausen, Wimpfen and the Wartburg in Germany, Auxerre in France, and (of the Dukes of Granada) in Estella, Spain.

The gradual growth of communal organization led

to the building of various communal buildings. Town halls began to become common in the 12th century. A typical example is that at St. Antonin, in France, made over from an old residential hall. The Casa Consistorial at Lerida, Spain, is another remarkable example. Many of the Bargellos of northern Italy were also begun in the 12th century, though their present condition usually represents many rebuildings. An Italian characteristic is the frequent combination of civic functions with the residence of the presiding or commanding officer. (See GOVERNMENTAL ARCHITECTURE.)

Local Schools. Despite the international character of Romanesque influences because of the monasteries, local materials and traditions markedly affected even monastic buildings and produced various easily distinguishable local schools. These are: *Lombardy*: characterized by simple surfaces; concentrated grotesque ornament; lavish use of pilaster strips and arcaded cornices; great structural ingenuity; the alternate large and small supports; groined vaults, sometimes ribbed; and highly developed crypts, in the later work opening into the nave, under the choir, across a large part of the width of the church. *Rome*: characterized by simple structure; the free use of classic forms; and in the 12th and 13th centuries, a highly-developed school of decorative mosaicists, decorating with rich mosaic not only floors but also pulpits, altar rails, and even columns, as in the cloister of St. Paul's Outside the Walls. *Tuscany*: characterized by the use of classic Roman details; much small arcading and colonnading on the exterior; and the lavish use of polychrome marble sheathing and banding. *Sicily*: characterized by a mixture of Norman, Roman and Byzantine influences, with occasional forms borrowed from Arabic, Egyptian, or Saracenic architecture. *Provence*: characterized by barrel vaults; one-aisled churches; rich cloisters, and a lavish ornament based on Roman classic forms. *Auvergne*: characterized by churches with nave and side aisles; side aisles with vaulted triforium galleries above; absence of clerestories; rich and complex east ends with many chapels, and exteriors decorated with patterns of colored stones. *Aquitaine*: characterized by the great use of domes; simple interiors, and in Bordeaux, Poitiers and the neighborhood, by extremely rich west fronts covered with sculpture and arcading. *The Rhine country*: characterized by Lombard structural and decorative influences; simple vaulted naves of great relative height, with one bay of nave to two of the aisles; double-ended churches, with apses at both ends; and many towers, giving great picturesqueness of outline. *Burgundy*: characterized by strength of Roman influence; highly developed barrel vaulted churches with aisles, triforia and clerestories; complexity of plan; deep covered and enclosed porches; and great structural initiative. *Normandy and England from the time of the Norman Conquest*: characterized by structural initiative and inventiveness showing in the development of the ribbed and six-part vault; simplicity of detail; Lombard influence; geo-

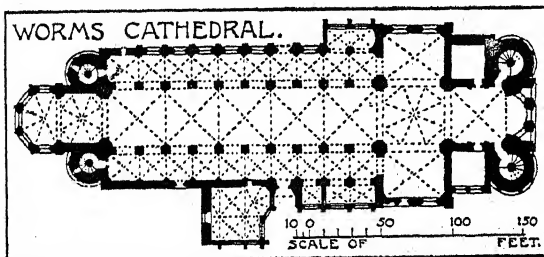
metric ornament, and the rich development of towers. *Saxon England*: characterized by small size of the buildings, great relative height, crude naïveté, simplicity and the use of a decoration of strips of stone



FROM F. M. SIMPSON, A HISTORY OF ARCHITECTURAL DEVELOPMENT, LONGMANS, GREEN & CO.

SECTION OF THE CATHEDRAL AT SPEIER (SPEYER), GERMANY

perhaps reminiscent of timber building. *Spain*: characterized by architectural forms similar to those of southwest France, and by an exceptional skill in vivid architectural sculpture.



FROM F. M. SIMPSON, A HISTORY OF ARCHITECTURAL DEVELOPMENT, LONGMANS, GREEN & CO.

PLAN OF THE CATHEDRAL AT WORMS, GERMANY

In general, Romanesque architecture is important as that in which the problems of western church design were clarified and the first adequate solutions developed. It produced the stone vaulted church, with nave and aisles, transepts and crossing, an apse or sanctuary surrounded by an ambulatory and subordinate chapels. It developed the three-fold height division of pier arch, triforium and clerestory. It created the tower and spire, and finally it decorated the whole with ornament and sculpture of tremendous vividness and richness. Its effect is one of power and vitality; except in Tuscany, Rome and parts of South Italy it is usually somber, massive, impressive. But it is in no sense a completed style; it is the work of men striving out of the Dark Ages, with a marked inferiority feeling; of men over-tense, neurotic, full often of sadism, cruelty, and themselves afraid; peoples not yet masters of the civilizations they had developed.

T. F. H.

BIBLIOGRAPHY.—E. E. Viollet-le-Duc, *Dictionnaire raisonné de l'architecture française du XI au XVI siècle*, 1854-68;

H. A. Revoil, *L'architecture romane du midi de la France*, 1873-74; Ruprecht-Robert, *L'architecture Normande aux XI et XII siècles en Normandie et en Angleterre*, 1885-87; R. Cattaneo, *Architecture in Italy from the 6th to the 11th Century*, Eng. trans., 1896; G. T. Rivoira, *L'Origini del' Architettura Lombarda*, 1901; C. Martin, *L'Art Roman en Italie*, 1912-24; Sir T. G. Jackson, *Byzantine and Romanesque Architecture*, 1913; A. K. Porter, *Lombard Architecture*, 1915-17, and *Romanesque Sculpture of the Pilgrimage Roads*, 1923; C. Enlart, *Manuel de l'archéologie française*, 1919-24; E. Male, *L'art religieux du XII siècle en France*, 1922; J. Strzygowski, *Origins of Christian Church Art*, trans. by Dalton and Braunholtz, 1923; C. Ricci, *Romanesque Architecture in Italy*, Eng. trans., 1925; C. A. Cummings, *A History of Architecture in Italy*, new ed., 1927; J. Baum, *Romanesque Architecture in France*, Eng. trans., 1928; G. Gromort, *L'architecture romane en France*, 1928-31.

ROMANESQUE ART. The term Romanesque corresponds with that of Romance as applied to the group of languages arising out of the Roman tongue. An art manifestation in those countries which came under Roman influence is generally described as Romanesque. In this sense Romanesque art extended roughly from the dissolution of Charlemagne's empire in 843 through the 12th century. About the year 1000 a new religious faith infused Europe, which led to an almost universal rebuilding of churches in a new style; this style is described in the article on ROMANESQUE ARCHITECTURE. The monastic orders, which had arisen as a protest to the degradation of the Church, had in turn become lax in rule. Reformed orders were formed, leading to the erection of vast monastic establishments. The Cluniac order alone possessed 2,000 monasteries. The abbot, as head of an order, was second only to the Pope, and the abbott church over which he presided was constructed to reflect his power. It was natural that the fine arts under the domination of the monastic orders should find expression in church building, and that church decoration should be dictated by the need of teaching the unlettered by pictorial representations. Romanesque art stands as an example of organized Christianity. At first an art borrowed from the Roman temple, and revealing Oriental influence, under the direction of the monk architect and theologian and executed by the monk craftsman, rules and traditions were evolved and consolidated which were later to be developed and expanded into the elaborate symbolism of the Gothic style.

Romanesque sculpture and painting, closely related, were subservient to architectural design. Ornament centered chiefly round the pillars and capitals. The decoration of the capitals with isolated figures was a characteristic feature. The pillars were covered with interlacing designs of men and monsters, suggesting the combined influence of



FROM M. H. OF ART PHOTO

VESICA OF WEST PORTAL, CATHEDRAL OF ST. TROPHIME, ARLES, FRANCE

the intricate scroll-borders on illuminated manuscripts and the design motives in Persian carpets. That this fantastic ornamentation was not wholly of didactic intent to appeal to the ignorant with vigor and flamboyance, in order to leave a permanent impress on the mind, but was governed largely by the caprice of the monk-artist is indicated by St. Bernard's invective against such practice. Mural frescoes were of simple flat design, and stained-glass was used in the few window openings; but it was not to come into its full glory, as also with the art of illumination, until the Gothic period. One of the greatest treasures of the Romanesque era is the Bayeux tapestry, of about 1150, valued because of its historical importance as a pictorial record of the times; its representations embrace 72 scenes in the conquest of England by the Normans.

ROMAN FESTIVALS, celebrations observed by the Romans. Some of these festivals were fixed by the calendar; others were set by the magistrates or priests, while still others were observed on special occasions, such as an emergency or the celebration of a victory. Some 45 holidays were fixed by the calendar. The festivals were either of a private or public nature, private celebrations being observed by special families or individuals.

One of the most important of Roman festivals were the *Feriae Latinae*, an ancient ceremony observed by the Latins and taken over by the Romans. It consisted of the sacrifice of a bull, parts of which were distributed to the various towns participating. The sacrifice was made to Jupiter at Mt. Alban. The time of the festival was set by the consuls upon assuming office, and officials were not allowed to undertake their duties until the festival had been held. Originally lasting only a day, the festival was extended to four days' duration. Other festivals were the *Sementivae* or *Paganalia*, the harvest festival, observed in particular in rural communities; the *Lupercalia* celebrated on Feb. 15 around the Palatine for the purpose of fertility or fruitfulness; and the *Carmentalia*, having special reference to child-bearing. One of the most famous Roman festivals was the *Saturnalia* held at the time of the winter solstice. Schools were closed, public business suspended, slaves temporarily freed, and truces observed in time of war. Friends exchanged gifts, and a spirit of good will prevailed.

ROMAN LAW, the law of the city of Rome which with the development of Roman power became the law of the ancient world. The classical period of the Roman law extends from the reign of Augustus to the end of the first quarter of the 3d century A.D. The classical Roman jurists who wrote for the most part in the age of the Antonines and the first quarter of the third century left a body of writings which have been a quarry of rules of law and legal doctrine for all subsequent time. These jurists were succeeded by an age of legislation and codification from the time of Diocletian to the reign of Justinian. In the 6th century under Justinian Roman law was codified, legislation being compiled in a collection

known as the Code, and extracts from the writings of the jurists compiled and put in systematic order in the Digest or *PANDECTS*. In addition statutory authority was given to an institutional book known as the *Institutes*. These with the subsequent legislation of Justinian known as the *Novels* comprise the *Corpus Juris Civilis*, or body of the civil law, and are the final authoritative form of Roman law in the ancient world. With the revival of study of the Roman law in the Italian universities in the 12th century, Roman law spread gradually over Western Europe, and the civil law, or modern Roman law, became the basis of legal systems in Continental Europe and the countries colonized therefrom. It is now the basis of the law in Continental Europe, in Scotland (where it was received in the 16th century), in Central and South America, in South Africa and generally in countries settled by the French, Spanish, Dutch or Portuguese. In North America it is the basis of the law in Quebec and Louisiana.

ROMANO, GIULIO. See GIULIO ROMANO.

ROMANOFFS, the Russian royal family of the period 1613-1918. Originally the Romanoffs were Prussian but in the 14th century they settled in Russia and began to be associated as nobles with the ruling house of Rurik. In 1613, after a war of succession which had lasted 10 years, a council of boyards or landowners, elected Michael Romanoff, a boy 13 years old, as Tsar. He reigned until 1645 and was succeeded by his son Alexis, who died in 1676. After the death of Feodor, his eldest and weak-minded son, in 1682 the Strelitzes, the Tsars' noble bodyguard, proclaimed his brothers, Ivan V, an imbecile, and Peter (see PETER THE GREAT), a boy of 10 years, as Tsars under the regency of their masterful sister, Sophie. In 1689 Peter asserted himself, ended the regency and sent Sophie to a convent. He is known as Peter the Great, and his reign marks a great advance by Russia toward the west. He died in 1721 and was succeeded by his widow, Catherine I, 1725-27, his son Alexis having been executed by order of his father. Upon the death of Catherine, PETER II, 1727-30, succeeded. On his death from smallpox, Anna Ivanovna, daughter of the elder brother of Peter the Great, was elected to the throne. She died in 1740, and for a year her grandnephew, Ivan IV, though an infant, was Tsar. But a conspiracy resulted in his close imprisonment and murder in 1764.

Elizabeth, the youngest daughter of Peter the Great, seized the throne, holding it from 1741-61, but leaving no heirs. Her elder sister, Anne, had been married to the Duke of Schleswig-Holstein-Gottorp. Their son, Peter III, reigned briefly, 1761-62, when he was strangled by order of his wife, CATHERINE THE GREAT, 1762-96, whose remarkable reign continued the westward expansion of Russia begun by Peter the Great and the extension of Russian power on the Black Sea. Her eldest son, Paul, became Tsar in 1796, but in 1801 he was strangled by conspiring officers and the throne passed to his sons, ALEXANDER I, 1801-25, and NICHOLAS I, 1825-55, the second son, Constantine,

withdrawing in 1825. Upon the death of Nicholas I in the closing year of the CRIMEAN WAR his son ALEXANDER II, 1855-81, popularly known as the "Tsar Liberator," succeeded. His assassination brought his autocratic son, ALEXANDER III, 1881-94, to the throne. He was in turn succeeded by his son, the unfortunate NICHOLAS II, 1894-1918, the last of the Romanoffs, who was forced to abdicate in March of 1917, imprisoned and shot at the small Siberian town of Ekaterinburg, by the Bolsheviks. Along with him the Reds also put to death the Czarina, Alex of Hesse, their son and heir, Alexis, and their four daughters. It is claimed that one grandduchess, Anastasia, escaped.

ROMAN REPUBLIC. The first Roman Republic in modern times was proclaimed by Napoleon in Feb. 1798 after the captivity of Pope Pius VI. But it did not last long. During the absence of Napoleon in Egypt the French were defeated in Italy, the Republic was abolished and the Pope returned to the Vatican. The Second Roman Republic was established in 1848 in connection with the national revolutions of that year. In spite of his liberalism and advocacy of reform a spectacular uprising forced Pius IX to flee. The city was organized as the Roman Republic under the two republican leaders, Mazzini and Garibaldi. The next year, 1849, however, the struggle to free Italy was crushed, the revolutionary governments were swept away, and the Roman Republic overthrown with the aid of French armies.

ROMAN REVIVAL STYLE, a style resulting from the conscious attempt to base a modern architecture on the actual forms developed in ancient Rome, current in large parts of Europe and in the United States at the end of the 18th and the beginning of the 19th centuries. A new interest in the power and richness of ancient Roman work was evident in England, France and the United States as early as 1750. A reaction against the frivolity of the rococo and the elaborateness of the baroque was due. The American Revolution, and still more, the French Revolution, by sweeping away many of the Renaissance traditions, offered a great opportunity for the new developments, and furthermore at that confused time the late Republican and early Imperial periods in Rome, seen through the mist of sentimental retrospect, seemed a veritable golden age. The architectural result of this was necessarily a Roman Revival, which accordingly governed all the official building of the early years of the United States, and a little later, all the official building of the Napoleonic regime in France, and some in Italy and Denmark. In general the Roman Revival yielded to other influences between 1820 and 1850, but the tradition of monumental grandeur it left has exerted a marked influence.

At its best, the Roman Revival work is dignified, large in scale and magnificent; at its worst it is dull, insincere and ostentatious. For bibliography see under MODERN ARCHITECTURE.

ROMANS, EPISTLE TO THE, the sixth book in the New Testament, is a letter generally believed

to have been written by the Apostle Paul to the Christian community at Rome, which was composed of both Jewish and Gentile converts. It is assumed that the letter was written from Corinth about 58 A.D. In the 15th chapter, the writer says that he hopes to visit Rome on his way to Spain, and in the next chapter, he greets many of the Christians in Rome by name, which leads some scholars to think either that the letter has a later date or that this section was added later. The most radical views find the epistle a treatise, rather than a letter, compiled from earlier Pauline MSS., and date some sections of it as late as 120. Its main theme is the doctrine of justification by faith, with special reference to the relation of Jews and Gentiles respectively to the Jewish law, the rejection of the Jews and the opening of the doors of the church to the nations. The epistle, after introducing its main theme, outlines the new Christian life and character which result from faith and from freedom from the old law. Chapters 9 to 11 treat of the unbelief of the Jews, interrupting previous discussions, and are thought therefore by some to be an interpolation. The thread of practical precepts is taken up again in Chapter 12, which is one of the most esteemed chapters in the entire New Testament.

ROMANTICISM, a term applied to literature which is subjective, imaginative, colorful and marked with sympathy for the past; as contrasted with objective, formal literature (CLASSICISM) and with literal transcriptions of life (REALISM). Romantic literature is found in all periods, but a marked revival occurred in the 18th century, to replace that written in accordance with classical Latin rules. Although the earliest signs of the movement appeared in England, its expression there was less extreme than in Germany, but was largely a return to the naturalness of Chaucer and Shakespeare and to the first-hand observation of Nature. The publication of *The Seasons* by James Thomson, about 1730, gave rise to the "landscape poems," such as Gray's *Elegy* and Goldsmith's *Deserted Village*, and later to the descriptive poetry of Byron, Scott, Wordsworth, Keats and Shelley. Another type of Romanticism, that preoccupied with medievalism, began with the publication of *Fingal*, 1762, and *Temora*, 1763, which purported to be translations of the poems of OSSIAN, and also with the *Reliques of Ancient English Poetry*, published by Thomas Percy, 1765. Romanticism of this type reached its greatest height in England after the publication of Horace Walpole's *Casle of Otranto*, 1764, which introduced the ghost romance and "Gothic" elements into literature and reached its high point in Coleridge's *Ancient Mariner*. The ghost romance was later supplemented by the historical romance, a form in which Sir Walter Scott excelled.

In France, the beginnings of the Romantic movement are found in Rousseau's *Confessions*, 1781-88, which brought naturalism to French letters. Chateaubriand, Mme. de Staël, Victor Hugo, Alfred de Musset, Dumas, de Vigny, George Sand and Gautier—all of the 19th century—are the outstanding authors

of the school. In Germany, Goethe's *Weither*, 1774, marks the foundation of Romanticism, and Herder, Schiller, Heine, Tieck and the Schlegels are its most prominent figures. See also STORM AND STRESS.

In America, the influence of speculative thought from abroad led to the Transcendentalists, of whom Emerson (*Essays*, 1841-44, and *Poems*, 1847) and Thoreau (*Walden*, 1854, and *Excursion*, 1863) were conspicuous. The Transcendentalists were followed by Longfellow, Lowell, Holmes, Hawthorne and Edgar Allan Poe, whose verse and tales of ghostly adventure follow one element of the European Romantic tradition more closely than does the work of any other American author of the period. See also ENGLISH LITERATURE; FRENCH LITERATURE; GERMAN LITERATURE; AMERICAN LITERATURE; separate articles on above authors.

BIBLIOGRAPHY—H. A. Beers, *A History of English Romanticism in the Eighteenth Century*, 1899, and *A History of English Romanticism in the Nineteenth Century*, 1901, C. E. Vaughan, *The Romantic Revolt*, 1907, I. Babbitt, *Rousseau and Romanticism*, 1919, L. Abercrombie, *Romanticism*, 1926

ROMANTICISM, in painting, a name applied to a movement which began in 1819 as a rebellion against the rigidity and dogmatism of CLASSICISM. In French painting it was an opposition to the serenity, balance and formalism of David's School of Classicism, which had remained supreme during the years of the Revolution, Consulate and Empire. Instead of the qualities of the Classicists, the Romanticists sought vehemence, movement and drama in their painting. Géricault (1791-1824), with his *Radeau de la Méduse* in the Salon of 1819, was the first to open the conflict on the Romantic side in the artistic contest which divided France between 1830 and 1870. But EUGENE DELACROIX (1798-1863) is regarded as the founder of the Romantic School; a born colorist, with a critical analytic mind and creative imagination, steeped in Dante and Shakespeare and with an eye trained to a naturalistic observation, he was a fit storm center for those who declared their right to a free expression of personal impressions. JEAN AUGUSTE INGRES (1780-1867) led the classic forces, but like David, by whom he was trained, he was at heart a realist and a great portrait artist. Neither of them, however, understood the source of their strength. Delacroix, primarily a portraitist and colorist, embodied the best and strongest elements of the Romantic movement, and almost alone fought for its recognition. The BARBIZON SCHOOL was a naturalistic development of Romanticism; the luminosity of Delacroix's coloring, which he learned from Constable, found a fuller expression in COROT. Another outgrowth of this movement was the ECLECTIC SCHOOL started by Delaroche, which gave itself up to the current taste for historic melodrama. With Delaroche were associated Ary Scheffer, Horace Vernet and Couture. Intensity of feeling gave place to outer trappings and a clever pretentiousness and sentimentality.

BIBLIOGRAPHY—Pauli, *Die Kunst des Klassizismus und der Romantik*, 1925, Rosenthal, *L'Art et les Artistes Romantiques*, 1928.

ROMANY or GYPSY, the language of the Gypsies, belonging to the Indian branch of the INDO-IRANIAN linguistic group. Originally a dialect of northwestern India, it has been carried since the 5th century through Persia and Armenia to all parts of Europe. Though strongly influenced by every language with which it has come in contact, its numerous dialects retain marked traces of its provenance.

BIBLIOGRAPHY—F. Miklosich, *Über die Mundarten und die Wanderungen der Zigeuner Europa's*, 12 parts, 1872-80, J. Samson, *The Dialect of the Gypsies of Wales*, 1926

ROME, the capital of the kingdom of Italy since 1870, and for more than a thousand years before the seat of the Papal Court, with a long history of imperial grandeur. It is located in west central Italy, on the banks of the Tiber about 17 mi from the Mediterranean. In the 8th century B.C. Rome could have been described as a small castle on a small hill. Legend states that the hill was dedicated to Pales, hence its name of Palatinus, and that the village about its summit was called *Roma Quadrata* from its square form. The Seven Hills of Rome which the city occupied in the 6th century B.C., were Mts. Palatinus, Capitolinus, Quirinalis, Caelius, Aventinus, Viminalis and Esquilinus. These hills can be identified to-day, the Palatinus still being the most noteworthy, for on it are the ruins of the palaces of the Caesars and of the great patricians.

Ancient Rome was a city of small and crooked streets until after its destruction by fire in Nero's reign, when wide streets took their place, to accommodate the population of 1,000,000 said to have then resided in the city. Of the temples, palaces, public halls, theaters, amphitheaters, baths, porticoes, and other monuments of that age few ruins remain. A monumental record of 540 A.D., published by Cardinal Mai, mentions 324 streets, 2 capitolis—the Tarpeian and that on Mount Quirinalis—80 gilt statues of the gods, of which only the Hercules remains, 66 ivory statues of the gods, 46,608 houses, 17,097 palaces, 13,052 fountains, 3,785 statues of emperors and generals in bronze, 22 great equestrian statues in bronze, of which only the Marcus Aurelius remains, 2 colossi,—the Marcus Aurelius and the Trajan—9,026 baths, 31 theaters, and 8 amphitheaters. The Pantheon, a temple dedicated to various gods and said to be the most perfect monument of ancient Rome, erected by Agrippa in 27 B.C., was transformed by the Emperor Phocas, 609 A.D., into a Christian church and to-day is St. Mary's of the Martyrs. Its history is one of spoliation, the last to carry away materials being URBAN VIII (1623-44), who took the bronze from the roof of the portico to make the *baldachino* in St. Peter's. Of the great amphitheaters, that of TITUS, finished in 80 A.D., and known as the Flavian Amphitheater, was the finest and its ruins can now be seen as the COLISEUM. Except in a few places, the walls of the ancient city have entirely disappeared, though their position is traceable. The fragmentary portions that remain, dating mostly from the 3rd century A.D., are of brick with some stone

work, and on the outside are about 55 ft. high. Many of the 12 gates that were left have since been walled up or used as railway entrances.

The modern city reached its present limits in the 17th century when, under Urban VIII and Innocent X, the Janiculum and the Vatican hills were enclosed. The famous Roman baths are gone, with the exception of the ruins of those of Diocletian, Titus and Caracalla. Those of Diocletian are the largest and the most magnificent, dating from 302 A.D., but they have been transformed in part into the Church of St. Bernardo. In 1561, Pius IV gave the ruins of these baths to the monks of the Certosa, who used much of the material for the construction of their monastery, while the old *tepidarium* was used by MICHELANGELO to construct the Church of St. Mary of the Angels. The Baths of Titus can be partly discerned on Mt. Esquilinus. The Baths of Caracalla, extensive and impressive even in their ruins, are the chief *Thermae* visited to-day, as they have not been converted to any modern use. The modern traveler is free to reconstruct their ancient splendor in his imagination. The principal triumphal arches, those of Titus, 81 A.D., Severus, 203, and that of CONSTANTINE, 311, all in or near the Forum, can still be seen and are fairly well preserved. Among the theaters, those of Pompey, Cornelius Balbus and Marcellus were the finest. The Palazzo Cenci is now on the site of the theater of Balbus. Of the theater of Marcellus there are but few remains: only the caves and the external arches of the two lower stories. The great Circus Maximus, which was capable of accommodating 260,000 spectators is now the site of many buildings, including the chapel of the old Byzantine court, at present the Church of St. Anastasia, on Mount Palatinus. Jupiter Capitolinus, the oldest and most sacred temple of ancient Rome, disappeared long ago and its site has had a history typical of many other noteworthy spots in the city. In medieval days the famous spot was so neglected that it became known as Goat's Hill. It held a church, a convent and a few ruins. The site was donated by the Emperor CHARLES V, to his page Caffarelli, for a palace. This was afterwards acquired by Prussia, which established the German embassy to the Quirinal there from 1879 to 1914. In 1919 the Caffarelli Palace was torn down. Most of the treasures found in Roman ruins have been removed to museums scattered all over Europe and other continents. That there are such remains of ancient Rome as exist to-day is due in part to the interference of RAPHAEL, who implored JULIUS II, early in the 16th century, to "protect the few relics left to testify to the power and greatness of that divine love of antiquity whose memory was an inspiration to all who were capable of higher things."

Before describing modern Rome, it should be noted that the city of to-day differs considerably from the city as it existed under the popes, for since the establishment of modern Italy, many of the points of interest which attracted visitors and scholars a century

or less ago have disappeared. Travelers like Augustus J. C. Hare even went so far as to write that "Sardinian rule has done more for the destruction of Rome than the invasion of the Goths and the Vandals." It is not without some significance, however that about the time Hare wrote these words, there was born in Italy one BENITO MUSSOLINI, who in recent years, among many other reforms, has devoted much of his time to the revival of interest in the preservation of artistic and historic sites. Fascist public works have included work on Mt. Capitolinus, whose slopes have been freed from all the parasitic structures superimposed upon it during many past centuries, so that it begins to assume its original aspect. The ramshackle houses about the Theater of Marcellus have been torn down, and the side of the Capitoline rock thus exposed has become a magnificent background, against which the ancient theater is thrown in bold relief. Best of all, the famous Tarpeian Rock has been uncovered, so that the modern visitor can see what is believed to be the place from which traitors were hurled to destruction. The entire project of isolating the Capitol has brought to light numerous works of the past, including remains of ancient temples which had been built over with cheap houses or buried under débris. Whether this revival of interest will again give the world the Coliseum as it stood before 1870, the glorious cloisters of MICHELANGELO before they were walled up, and various other precious monuments which later ages deemed insignificant, remains to be seen.

Since Rome became the capital of modern Italy it has taken on the aspect of other metropolitan centers and has become a beautiful city of wide thoroughfares, great squares and magnificent buildings. The reputation it had in medieval days as unsanitary has been destroyed by its great system of drainage, modern paving and other improvements. The city is now divided into 14 departments or *rioni*, 12 of which are on the right bank of the Tiber and two on the left. These latter include the ancient Janiculum Hill, with the Botanic and Corsini Gardens. Adjoining is the famous Castel Sant' Angelo and the recently created VATICAN CITY, which is now under the complete sovereignty of the Pope and includes the Vatican palace and gardens with St. Peter's. The three finest streets, the Corso, the Strada del Babuini and the Strada di Ripetta diverge from the Piazza del Popolo near the north gate, the former leading directly to the Capitol and the Forum. There are in the city several fine palaces and villas, the latter erected in beautiful gardens, the principal being the Villa Borghese whose gardens provide the city with its most fashionable promenade. Other famous villas are the Colonna, Corsini, Medici, and Pamphili, all of which can be entered by the public at certain hours. The principal palaces are the Doria, the Ruspoli, the Orsini, the Farnese and the Barberini, each of which has its history and special interest.

Rome is also a city of churches, about 360 in number, the most famous being St. PETER's and the most

ancient the Church of St. John Lateran. Besides the numerous ancient Catholic edifices, there are a few modern Protestant places of worship, Episcopalian, Methodist and the Presbyterian. There are many churches specially favored by the nationals of other countries. The three which serve the English are San Silvestro in Capite, St. George and the English Saints, and St. Thomas of Canterbury. The two which serve the Irish are Santa Agatha dei Goti and Sant' Isidoro. The Scotch patronize St. Andrew's. American Catholics commonly attend Santa Susanna's in the Via Ventù Settembre and the Church of the Immaculate Conception in the American College, in Via Umlta.

Special itineraries have been planned for tourists. One afternoon is often consumed in visiting the Appian Way, the Baths of Caracalla, the Circus Maximus, the Tomb of the Scipios, the Arch of Drusus, the Porta San Sebastiano, the Aurelian Walls, the Church of Domine Qua Vadis, the CATACOMBS, the Circus Maxentius, the Tomb of Cecilia Metella, with a distant view of the ancient aqueducts, and the Alban and Sabine mountains. Another afternoon provides the guide a chance to describe the Church and Cemetery of the Capuchins, the Villa Borghese, now called Villa Umberto, the Pincian Hill, the Ghetto, the Theater of Marcellus, the so-called Temple of Vesta and the Temple of Fortuna Virilis, the island Tiberina, the English cemetery with the graves of Keats and Shelley, the Pyramid of Caius Cælius and the Basilica of St. Paul's-Outside-the-Walls. In a similar hasty manner, the VATICAN is seen and described in four hours.

The best general view of the city is from the Janiculum Hill, whence the outlook emphasizes the most impressive fact in any description of Rome: the astonishing blending of ancient and modern features. Where fine steeds once galloped, drawing the chariots of emperors, taxis and street-cars now run, and all-night trams traverse the ancient Flaminian Way. The Via Appia, built in 312 B.C., is now a regular motor bus route. The templed hill occupied by the Sabines at the dawn of the city's history now provides the foundation of a modern royal palace. The Fontana di Trevi is still supplied with good water from the aqueduct built by Agrippa in 27 B.C. A railway now runs past the ruins of the Temple Minerva, post and telegraph offices are to be found in the old Dominican monastery. Palatial hotels, banks and business establishments now occupy sites once traversed by the legions which conquered the world. Where Caesar fell in 44 B.C. now rises a richly decorated church. Such are characteristic features of Rome, the Eternal City.

In Rome, as throughout Italy, the executive authority is exercised by the king, acting through his minister. The legislative authority is vested in the king and parliament. A law passed in 1920 provided universal suffrage for all men and women. In 1925, Rome was deprived of municipal government and its administration placed in the hands of a governor, appointed by the decree of the king. In 1927 Musso-

LINI, as Premier, promulgated the "Fascist Charter of Labor." This gives the state the right to control all factors of production and to act as the guardian of both labor and capital.

Besides native Italians, there are living in the city large numbers of French, Greeks, Slavs, Spanish, Germans and Croats. According to the census of 1931, the population, including the suburbs, was 1,008,083.

ROME, ANCIENT, HISTORY OF. The origins of Rome go back to the transition from the Bronze to the Iron Age in Italy, about 1100 B.C. At this time people of Italic stock pushing southwards from the Po valley established themselves in Latium. Among other places they settled on the south bank of the Tiber about 15 miles from the sea, where some low eminences made an excellent site for their agricultural villages. By the unification of these villages, whose population had been reinforced by later Italian immigrants, the historic city of Rome was formed, probably towards the close of the 7th century B.C. Not long afterwards Rome was seized by an Etruscan dynasty which ruled it until the close of the 6th century. Although the traditional history of this period is quite untrustworthy, it is clear that under the Etruscan kings Rome became the leading city-state in Latium, conquering and absorbing several adjacent communities. Under them also the Romans made some progress in industrial development and came into commercial contact with the Carthaginians and the Greeks. In 509 B.C. the last Etruscan king was expelled by Romans who established a republic with two annual presidents, called consuls.

Unification of Italy and Rise of Plebs: 509-265 B.C. In the two centuries and a half which followed the expulsion of the Etruscans, the Romans united peninsula Italy under their control. In this process of expansion the cities of the Latin plain were incorporated in the Roman state, while the other peoples of Italy, Italians, Etruscans, Greeks and Illyrians, were reduced to the position of dependent allies. Although sacked by the Gauls in 387 B.C., Rome ultimately held this foe in check and likewise frustrated the invasion of Pyrrhus, king of Epirus. Roman and Latin colonies occupied strategic points, and the territory of Rome grew from 350 to 10,000 square miles. The Roman success was due in part to superior military organization and discipline, in part to superior statesmanship. During this period the Roman state itself underwent a profound political transformation as a result of a prolonged struggle of the plebs or commons against the patricians, an hereditary aristocracy of landed families who enjoyed a complete monopoly of political and judicial authority. Led by their elected representatives, called tribunes, the plebeians gradually won political and legal equality by forcing the codification of the law, the Twelve Tables; gaining admission to the consulship and other magistracies; and, finally, winning the right to legislate in their own primary assembly for the state as a whole. Culturally

Rome still remained a backward state dominated by agrarian interests and neglecting commerce and industry. Etruscan and Greek influences were felt in Roman religion, but as yet there was no Roman literature. The adoption of a system of coinage and the construction of the first aqueduct and the first military highway, Appian Way, belong to the last half of the 4th century.

Conquest of the Mediterranean World: 265-133 B.C. By uniting Italy, Rome became a world power of first rank and was at once drawn into a series of conflicts with foreign states. The three Punic Wars fought with Carthage gave Rome the mastery of the Western Mediterranean and caused the destruction of her African rival. Four wars with Macedonia and one with Syria established Roman domination over the Greek East. Pergamon in Asia Minor fell to Rome by the will of its last legitimate king. Rome had now acquired territory in Sicily, Sardinia, Corsica, Spain, Africa, Macedonia and Asia Minor. This was organized into tributary districts called provinces ruled by governors sent out from Rome. At home the government was in the hands of a narrow circle of patrician and plebeian families who monopolized the offices and constituted a new nobility. But the growth of the empire caused the rise of an important class of business men interested in banking and state contracts, the new equestrian order. At the same time the devastation of south Italy by Hannibal and the prolonged foreign wars caused the ruin of the Italian peasantry and fostered the development of great plantations, or *latifundia*, operated by cheap slave labor. Rome itself had become a great city thronged with foreigners, slaves and a restless mob of landless citizens. Contact with the older culture of the Greek world had stimulated the growth of Latin literature and shaped the intellectual and cultural life of the Romans. Unfortunately, it also created a taste for luxury and reckless extravagance.

The Fall of the Republic: 133-27 B.C. The century which followed 133 B.C. was one of continual strife, frequently blazing forth into civil war between the senatorial aristocracy, which strove to retain its control of the government, and the popular faction, which voiced the widespread discontent with economic and political conditions. Taking advantage of this situation and of the opportunities afforded by foreign wars, a series of able individuals raised themselves to a dominant position in the state defying and weakening all constitutional authority. The greatest of these, Julius Caesar, in his dictatorship gave the death blow to senatorial rule and the whole republican system. His assassination led to a renewal of the civil wars from which his adopted son, the later Augustus, emerged as master of the Roman Empire. This period also saw the Roman dominions enlarged by the annexation of Bithynia and Pontus, Syria, Transalpine Gaul and Egypt, besides other smaller territories. The pirates were swept from the sea, and a great slave revolt in Sicily and Italy was crushed. The admission of the Latin colonies and Italian allies

to Roman citizenship spread the Roman municipal system throughout Italy and hastened the development of a Latin-speaking Italian nation. In this period, too, Roman intellectual activity reached its zenith and produced the Golden Age of Latin Literature, in which Cicero was the outstanding figure.

The Principate or Early Empire: 27 B.C.-284 A.D. Augustus reorganized the Roman Government by creating for himself the position of *princeps*, which involved the administration of the garrisoned provinces, the supreme military command and the powers of the tribunate of the plebs. For the next three centuries the principate was the dominant element in the constitution. It was an elective not an hereditary position, and its holders, the emperors, received their powers and titles from the Senate, although the choice of the Senate was usually determined by outside influences. From the outset the principate tended to encroach upon the powers of the old republican institutions. The popular assembly disappeared in the 1st century A.D.; the magistracies were reduced to municipal offices of the city of Rome, and the Senate was gradually deprived of any effective participation in imperial affairs. By the 3rd century the Emperor had concentrated in his hands all administrative, legislative and judicial authority. The administrative burden placed upon the emperors led to the development of the imperial civil service, a body of professional administrators who were recruited mainly from the equestrian order. They were appointed, paid and promoted by the Emperor, and were responsible to him alone. Their chief spheres of duty lay in the management of the public finances, the imperial domains and the imperial secretarial bureaus.

Augustus sought to put an end to the period of unrestrained imperialism and to find some natural and permanent frontiers to the empire. In Europe the line of the Rhine and the Danube; in Asia the upper Euphrates and the Arabian Desert; in Africa the Sudan and the Sahara formed the Roman boundaries. In general the succeeding emperors adhered to this policy; but the southern part of the island of Britain, the angle between the Rhine and the Danube, and Dacia to the north of the lower Danube, besides Arabia Petrea, were annexed by the early years of the 2nd century. The addition of these new districts led to the development of a system of permanent garrisoned fortifications along the unprotected frontiers like Hadrian's Wall across Britain and the line of defenses which ran from opposite Cologne on the Rhine to near Regensburg on the Danube. The army of the principate was a professional long-service establishment of about 300,000 men. About one-half of these formed the heavy infantry brigades or legions made up of Roman citizens. The rest, called auxiliaries, were organized in small infantry and cavalry detachments recruited from the provincials. An important part in the history of the times was played by the imperial bodyguard of 10,000 men, who were stationed at Rome and were known as the Praetorian Cohorts.

The establishment of the principate brought relief to the provinces which had been all but ruined by the civil wars and the ruthless exploitation of the republican administration. More than two centuries of peace and reasonably honest government raised the empire to a high level of economic prosperity. The seas were safe; good highways facilitated transportation; commerce and industry flourished. Under these conditions the Hellenistic culture of the East was fostered, and the Latinization of the less civilized West went on apace. An important factor in the latter was the extension of the municipal system of Italy to the provinces whereby these districts were filled with prosperous self-governing towns which served as nuclei for the spread of the Latin language and Roman law and political institutions. This movement culminated in 212 in the grant of Roman citizenship to all the members of provincial municipalities. To-day the ruins of these communities offer striking testimony to the material aspects of Roman civilization. Rome itself had become a great city of over a million inhabitants, adorned with imposing public buildings and monuments. About one-fifth of its inhabitants, however, were an idle, indigent mob of state pensioners, supported by a grain dole from the treasury and receiving free entertainment at numerous and costly public shows in the circus, the Colosseum, and the theaters.

A remarkable outburst of literary activity, marked by the works of Virgil, Livy and Horace, heralded the establishment of the principate. But a period of decline soon set in, and after the early years of the 2nd century no notable literary works were produced. Art experienced a similar fate, its early bloom being followed by a period of barrenness and imitation. The field of law alone offered an exception to the general intellectual stagnation that settled down over the empire, for it was the jurists of the 3rd century who completed the transformation of the Roman law from a local city law to a great imperial system based on fundamental legal conceptions.

The religious life of the principate was marked by the westward spread of the Oriental cults, a group of religions which had their rise in the countries of the Near East. They all taught doctrines of personal salvation and won a large following through their attractive religious ritual and the mystic ceremonies which appeal to the emotions of their initiates. For many of the upper classes of society Stoicism and Epicureanism were the real religion. But by far the most important religious development was the spread of Christianity. Although after 65 A.D. the Roman state regarded the Christians as enemies of the social order and punishable with death, yet it left them to be dealt with by local and provincial authorities and undertook no general action against them until about the middle of the 3rd century. At that time they had to undergo two severe but brief persecutions at the hands of separate emperors which checked but did not stop the rise of the new faith.

By the opening of the 3rd century the Roman world

showed unmistakable signs of economic collapse. The fundamental cause of this condition is uncertain; but a mistaken fiscal policy undoubtedly accentuated, if it did not actually produce, the crisis. At this juncture the empire was confronted by the revolt of the armies on the frontiers which plunged the state into civil war for a period of 50 years. The situation was rendered still worse by repeated barbarian invasions which penetrated to the heart of the empire and by devastating plagues which carried off a large percentage of the population. For a time separate states arose in Gaul and the East. But in the end the empire was reunited, order was restored, and the state entered upon a new period of life. Ancient civilization, however, had received its death-blow and could not be revived.

The Autocracy or Late Empire: 284-395. The organization of the revived empire was mainly the work of Diocletian, 284-305, and Constantine I, 307-337. The Government was an undisguised autocracy in which the ruler, although claiming to be elected by the officials, the army, the Senate and the people, based his rule upon divine right. He wore the diadem and other trappings of autocracy and was surrounded by an elaborate court ceremonial which made his person almost inaccessible. The imperial power was regularly shared by two or more Augusti or Caesars who administered separated parts of the empire. In the West, Milan and Ravenna superseded Rome as the imperial residence, and Constantinople became the seat of government in the East. The imperial authority was maintained by the army and the civil service. The former was recruited in large part from barbarians, who furnished the best fighting material. The officers now came from the same source; the old Roman discipline was relaxed; and mailed cavalry supplanted the legions as the backbone of the army. Large army corps were kept at strategic points in the heart of the empire, and the frontier defense was left to border militia. Below the emperor there was complete separation of military and civil authority. The civil service became an elaborate bureaucracy organized on military lines with control strictly centralized in the hands of the chief ministers of state whose subordinates penetrated to the remotest corners of the provinces.

The whole system was a hotbed of corruption but was so strong that it thwarted the efforts of the emperors to reform it. The municipalities had lost all vestiges of autonomy. Their propertied classes had become responsible to the state for the collection of taxes and the performance of public services, while their merchants and artisans, like those of Rome, were organized in hereditary guilds obliged to perform certain public duties. The agricultural workers became serfs, bound to the soil on which they lived. In short, the civilian population of the empire was divided into a number of hereditary castes, each with specific public obligations as the result of the futile attempt made by the Government to support the great military and civil establishment which it deemed es-

sential to maintain the empire. But the burden was too heavy; trade failed to revive; agriculture languished, and population declined.

A final effort to stamp out Christianity made by Diocletian and his colleagues failed of its purpose, and Constantine I reconciled the Christians and the state, giving the Church a preferential status and receiving its loyal support for the imperial power. His successors made Christianity the state religion and persecuted the adherents of pagan cults. An event of great importance was the settlement of the Visigoths to the south of the Danube, 376. To escape their enemies, the Huns, they sought refuge within the empire, but their mistreatment by imperial officials caused them to revolt. They annihilated the Roman forces in the East and only with great difficulty were induced to settle down as Roman allies, ruled, however, by their own kings.

The Fall of the Empire in the West: 395-476.

At the death of Theodosius I in 395, his two sons divided the empire into an eastern and a western half. In theory the two emperors were still colleagues sharing the same imperial power; but practically the two parts of the empire were independent states, each of which pursued its own policy without regard to the other's interests. As the western emperors proved to be weak and inefficient, the real power in the West passed into the hands of the commanders of the soldiery who were, for the most part, barbarians. These generals assumed the rôle of king-makers, nominating and deposing the emperors at will. Such conditions prevented effective resistance to new barbarian invasions. The Visigoths descended upon Italy, sacked Rome in 410, and eventually established themselves in southern Gaul and in Spain. The Sueves, Alans and Vandals seized parts of Spain; the Vandals conquered Africa; the Franks occupied the northern part of Gaul, the Burgundians the eastern. Although most of these invaders acknowledged the emperor as their overlord and the Visigoths in particular helped the Romans to defeat the Huns at Châlons, 451, the imperial authority hardly extended beyond Italy itself. Finally, in 476, Odovacar, the barbarian commander of the troops in Italy, deposed the Roman Emperor and proclaimed himself King. With this usurpation the Western Roman Empire came to an end. See ITALY, MODERN.

A. E. R. B.

BIBLIOGRAPHY.—T. Mommsen, *History of Rome*, trans. Dickson, 1905; W. E. Heitland, *The Roman Republic*, 1909; T. Rice Holmes, *The Roman Republic*, 1922; M. I. Rostovtzeff, *Social and Economic History of the Roman Empire*, 1926; A. E. R. Boak, *A History of Rome to 565 A.D.*, 1929.

ROME, a city in northwestern Georgia, the county seat of Floyd Co., situated at the junction of the Etowah and the Oostanaula rivers, where the Coosa River is formed. Three railroads and various river craft afford transportation. The city is a shipping center of the fertile cotton belt. Rome has textile mills and other factories. In 1929 the manufactures amounted to about \$7,000,000; the retail trade reached a total of \$11,020,515. This region was once inhabited by the Cherokee Indians. In 1540 De Soto visited

this site. Near here during the Civil War, a handful of Confederates, about 410 men, captured 1,600 Union soldiers. Rome was founded in 1834 and chartered in 1847. It is the seat of Shorter College and several private schools. Pop. 1920, 13,252; 1930, 21,843.

ROME, a city in Oneida Co., central New York, situated on the Mohawk River, Wood Creek and the State Barge Canal, 15 mi. northwest of Utica. Two railroads serve the city. Brass and copper products are the chief among other manufactures. The manufactured output for 1929 was valued at \$57,032,917. Ft. Stanwix was built on this site in 1758. A settlement sprang up soon afterwards. The fort was dismantled but repaired and garrisoned in 1776 as Ft. Schuyler, although the old name clung to it. The successful defense of the fort in Aug. 1777 aided in the great victory at Saratoga. The first time the American flag ever waved in battle was on Aug. 3rd, 1777 from the walls of Ft. Stanwix. Rome was incorporated as a city in 1870. Pop. 1920, 26,341; 1930, 32,338.

ROMEO AND JULIET, a lyrical drama of tragic love, by SHAKESPEARE; first printed 1597. It is based on Arthur Brooke's poem, *Romeus and Juliet*, 1562. At Verona, about 1303, the Montagus and the Capulets, two powerful families, are bitterly at odds. Thus tragedy is in the air when Romeo, a Montagu, falls deeply in love with Juliet, only daughter of the Capulets, and secretly marries her. Romeo is banished and the Capulets hasten to marry Juliet to the Count Paris. On the eve of her wedding to the detestable Paris, Juliet drinks a sleeping potion, prepared by the good Friar Lawrence, which so gives her the appearance of death that the still-living girl is buried in the tomb of the Capulets. Romeo returns and, in a midnight scene, kills Paris whom he finds keeping vigil, and, believing Juliet to be truly dead, takes poison and dies. Awakened from her enforced sleep, Juliet discovers her dead lover, and, in utter despair, stabs herself. By this double tragedy the Montagus and Capulets are reconciled. Minor characters are Mercutio, Tybalt, Juliet's nurse, and the comic servants.

ROMEO AND JULIETTE, an opera in five acts by CHARLES GOUNOD, libretto by Jules Barbier and Michel Carré, after the tragedy by SHAKESPEARE; première, Paris, April 27, 1867; first performed in the United States, Nov. 15, 1867, at New York. The opera ranks high in popular favor, and next to *Faust* is the finest work of the composer. Although the librettists were forced to delete much of the original drama, the opera narrative is substantially identical with the play by Shakespeare.

ROMNEY, GEORGE (1734-1802), English portrait painter, was born at Dalton-in-Furness, Lancashire, Dec. 26, 1734. After desultory studies in Paris he went to London, where he soon gained favor with his historical canvas, *The Death of General Wolfe*. In 1773, by which time his reputation was established and his income substantial, he visited Italy where he was much influenced by the work of Correggio.

About 1783 Romney met Emma Hart, afterwards Lady Hamilton, whose pretty face proved both his inspiration and his undoing. Always neurotic, Romney suffered a complete physical breakdown, which drove him back to Kendal; there he died in the arms of his long neglected wife, Nov. 15, 1802. Romney was a very uneven painter but at his best his portraits have rare charm and sweetness.

ROMULUS, in Roman mythology, legendary founder of Rome, was son of MARS and Rhea Sylvia, and twin brother of Remus. When infants, the brothers were nearly drowned, but rescued and nurtured by a she-wolf, from whom they were taken and brought up by a herdsman, Faustulus and his wife. When grown they restored their grandfather to the throne of Alba Longa, and then started to build a city on the shores of the Tiber. Romulus killed Remus because he laughed at the walls Romulus had erected on the Palatine Hill. Romulus completed the city and obtained wives for the citizens by abducting maidens from the Sabine tribes northeast of Rome. This led to a war with these people, but peace was finally made and Romulus was undisputed king. He was carried to heaven in a chariot of fire by his father, Mars. The Romans afterwards worshiped him as the god Quirinus.

RONCAGLIA, DIETS OF. The Emperor FREDERICK I (Barbarossa) on his first expedition into Italy in 1154 summoned an Imperial Diet at Roncaglia, where he received the homage of the barons and cities of Italy. On his second expedition in 1158 he crushed a League of Lombard cities headed by Milan, and summoned a second Diet at Roncaglia. This was attended by professors of the newly revived Roman Civil Law from Bologna, who at the Emperor's request formulated the imperial rights in Italy. They reported that tolls on roads, rivers and harbors belonged of right to the Emperor; that to him belonged the product of mines and salt works; that he had a right to levy on the cities for transportation of his troops; that he might levy extraordinary taxes; and finally, that he might legally appoint the chief magistrates in the cities. Frederick proceeded at once to exercise these powers.

RONDEAU, a French verse-form consisting in the *rondeau simple* of 13 8- or 10-syllable lines, eight of which are on one rhyme, five on another, separated by pauses at the fifth and eighth lines, and employing the opening words as a refrain in two places. In the *rondeau redouble* the form consists of 20 lines arranged in five quatrains (to which is sometimes added a sixth, the *envoi*), using successively the lines of the first quatrain to make up the last lines of the succeeding quatrains. Although an extremely difficult form, it is incomparable for rendering moods of lightness, grace and gaiety. In French, its masters were Clément Marot, V. Voiture and Alfred de Musset; in English, Tennyson, Swinburne, Dante, Gabriel, Rossetti, Dobson and Andrew Lang.

RONDEL, a French verse-form invented in the 14th century, similar to the RONDEAU. It consists

of 14 8- or 10-syllable lines employing two rhymes and divided into three stanzas in such a way that the initial couplet is repeated in lines 7 and 8, and 13 and 14, thus: *abba abab abbaab*. In 15th century France, the rondel was much used; in England the verse-form was revived in the 19th century and was adroitly employed by Dobson, Gosse, Robert Bridges and others. *See also* ROUNDELAY.

RONDO, a musical composition characterized by the return, or repetition, of a theme. In the strict rondo-form this main theme appears three or more times in the original key; between these repetitions episodic themes are interpolated. In the early part of the 19th century rondos as separate compositions were very popular, but the form is now preserved chiefly in the last movement of sonatas by Mozart and Beethoven.

RONSARD, PIERRE DE (1524-85), celebrated poet of the French Renaissance, was born in the Château de Poissonnière, province of Vendôme, Sept. 11, 1524. He began the career of a courtier at an early age. At 13 he became a page to James V of Scotland, serving about two years at that monarch's court in Scotland. Later he was employed on diplomatic missions by the Duke of Orléans. At 16, however, Ronsard was deafened by a severe illness, and two years later he retired from court life. He withdrew to the College of Couqueuret, where, with Antoine de Baif, Remi Belleau, Antoine Muret, JOACHIM DU BELLAY and others, he formed the group of seven poets famous in French literature as the *Pléiade*. It was the *Pléiade's* purpose to strengthen and rejuvenate the French language and to create a new poetry.

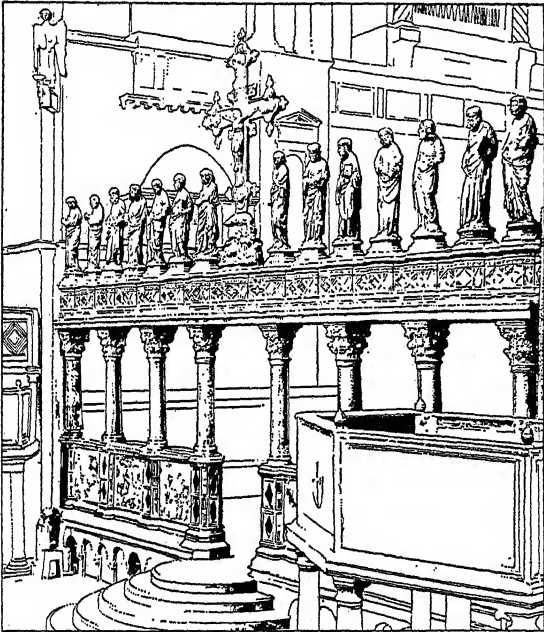
In 1550 Ronsard published his first book of *Odes*, followed in 1552 by the first volume of sonnets in his noted series called *Amours*. France was captivated by the freshness, charm and vigor of the new poet, and soon Ronsard was christened "the Prince of Poets." *Odes*, *Hymnes* and *Amours* succeeded each other rapidly, and in 1560 Ronsard issued the first edition of his collected works. The French monarch, Charles IX, took such pleasure in the four cantos of Ronsard's unfinished epic, the *Françiadé*, that he rewarded him with two priories and two abbeys. Ronsard was perhaps the most important poet of the French Renaissance. His best known poems sing either the praise of "Cassandra" or the theme of *carpe rosam* ("Gather ye rosebuds while ye may"). He was a master of technique, yet had gaiety and freshness. He greatly enriched the French language, rejuvenated and perfected poetic technique, and introduced into France the ODE. Ronsard died in his priory at Tours, Dec. 27, 1585. *See also* FRENCH LITERATURE.

BIBLIOGRAPHY.—A. A. Tilley, *The Literature of the French Renaissance*, 1904; J. A. A. J. Jusserand, *Ronsard*, 1913; Paul Laumonier, *Ronsard, poète lyrique*, 1923; C. H. C. Wright, *A History of French Literature*, 1925.

ROOD, a cross, hence a crucifix. The word is especially applied to the large crucifix of wood or metal hung above the JUBE, or rood screen, of churches.

In primitive usage a cross only, this became occasionally in the 10th century the figure of the crucifixion, and later the crucifix became general. Not until the 14th century, however, was the figure of Christ presented naturalistically: at first the Saviour appeared robed and crowned, and with no appearance of suffering. A rood beam is the wood beam which was sometimes used to span the chancel and support the rood.

ROOD SCREEN, a structure in a church separating the choir from the nave, usually surmounted by the Rood and its accompanying images. In the earlier Romanesque churches, it was a wall between the high choir and nave, in front of which, in the



ROOD SCREEN IN BASILICA OF SAN MARCO, VENICE

center, the altar for the laity was placed. Later the screens frequently occupied the entire width of the nave and were richly provided with figures, reliefs and ornaments. The oldest rood screens belong to the late Romanesque age and the most ornate to the early Gothic period. Among the finest examples are those in the Church of the Magdalene at Troyes, France; in the cathedrals in the German cities of Bamberg, Naumburg and Halberstadt, and in Basel. See also JUBE.

ROOK (*Corvus frugilegus*), an Old World bird of the CROW family common almost throughout Europe and especially abundant in the British Isles. It is about the size of a common crow and glossy black in color, with the skin of the forehead and throat bare, grayish and warty. Gregarious in habit, it moves the year round in noisy flocks and breeds in communities, often of vast size, known as rookeries. The bulky nests, in which are laid three to five greenish-blue eggs blotched and streaked with brown, are usually placed high in trees, frequently in groves

about old mansions. Rooks feed largely upon insects, but will eat almost anything, often devouring the eggs of other birds; their note is a crowlike caw. In the spring large numbers of the young rooks are shot for food. Though sometimes tamed, the rook is not as intelligent as the RAVEN, crow, or JACKDAW.

ROOM, in coal mining, called also chamber or breast, an opening in the seam of coal which is driven off at an angle to the CROSS ENTRY. Rooms are separated from each other by PILLARS, and the end where the coal is being mined is called the face, while the side along the pillar is known as the rib. See also ROOM-AND-PILLAR; BREAST; MINING COAL.

ROOM-AND-PILLAR, system of coal mining where coal is removed in sections, PILLARS being left between. Sometimes the pillars are left standing, but they are usually "drawn" from the far end toward the roadways. Failure to recover pillars often subjects mine owners to public criticism. See also BORD-AND-PILLAR; GROUND SUPPORT; ROBBING PILLARS; MINING COAL; ROOM.

ROOSENDAAL, a town in the Dutch province of North Brabant, a railroad center, with Protestant and Catholic churches. The town produces cigars, beet-sugar, brushes, account books and has transit trade. Pop. 1930, 22,030.

ROOSEVELT, FRANKLIN DELANO (1882-), American public official, was born at Hyde Park, N.Y., Jan. 30, 1882. He was graduated at Harvard in 1904 and in the next three years studied at Columbia Law School. In 1907 he was admitted to practice in New York State, and entered the firm of Carter, Ledyard & Milburn of New York City. Roosevelt identified himself with Democratic politics, and in 1910 was elected to the State Senate. He resigned in 1913 to accept a Federal appointment as Assistant Secretary of the Navy, a post he retained until 1920. During American participation in the World War, he served in the capacity of inspector of United States Naval forces in European waters, and in 1919 had charge of Naval demobilization. He was nominated as Vice-President at the Democratic National convention of 1920 on the ticket with James M. Cox. At the 1924 convention Roosevelt supported Alfred E. Smith, and placed him in nomination both there and at the 1928 convention. Roosevelt was elected governor of New York in 1928 and reelected in 1930. He has taken a firm stand on the water power development of New York State, believing that the State should itself develop the power and then lease it on favorable terms to private concerns, but that in the failure to obtain desirable terms the State itself should then arrange to deliver the power. He has also favored an extended program of public works in order to provide employment, the money to be raised by increased income taxes. By 1932 Roosevelt and Smith were political enemies and made strong fights for nomination as President at the Democratic Convention. Roosevelt was nominated, receiving 945 votes against 190½ for Smith. In the November, 1932 election, Roosevelt won the Presidency by an overwhelming majority.

ROOSEVELT, THEODORE (1858-1919), 26th President of the United States, born in New York City, Oct. 27, 1858. His father, Theodore Roosevelt, a successful glass merchant, belonged to a family which had come from Holland in the 17th century; his mother, Martha Bulloch, was of distinguished Southern ancestry. Theodore, frail in body, received his early education in the main from tutors. At Harvard, where he was graduated in 1880, he interested himself in history, economics and natural science, and began a *Naval History of the War of 1812* which is still regarded as authoritative. Soon after graduation, he married Alice Hathaway Lee of Boston, who died in 1884. In 1886, he married Edith Kermit Carew of New York.

In 1881, Roosevelt was elected to the New York legislature and immediately attracted attention as the leader of a small but effective group, fighting corruption and working for humane and progressive legislation. He was chairman of the New York delegation to the Republican Convention of 1884, but was defeated in his efforts to prevent the nomination of James G. Blaine. For the two years that followed, he lived in the Bad Lands of North Dakota where he established two ranches and lived the life of a hunter and cowboy. The experience was of vital significance in his development, inasmuch as it gave his abnormal energy an unfailing reservoir of physical strength and brought him an intimate understanding not only of the western heart and mind but of those fundamental aspirations and apprehensions which are common to all men.

He returned to the East in 1886, was an unsuccessful candidate for mayor of New York, published numerous books on ranch life and two biographies of early American statesmen, began a monumental history, the *Winning of the West*, took some part in Republican politics and, in 1889, was appointed, by President Harrison, a member of the U.S. Civil Service Commission. His efforts as nemesis of the spoils politician were effective, but his most important achievement was his dramatization to the public of the significance of civil service reform. His work as president of the police board of New York City (1895-97) strengthened his reputation throughout the country as a leader in the cause of civic decency.

In 1897, President McKinley appointed Roosevelt Assistant Secretary of the Navy. Believing war with Spain to be inevitable, Roosevelt set about with characteristic energy, and largely against the opposition of his immediate superior, John D. Long, to get the Navy ready. When war was declared he joined with his friend Leonard Wood, a captain in the Army Medical Corps, in organizing and training a regiment of mounted riflemen, recruited in the main from the southwest territories but including also a number of eastern clubmen and college athletes. The association in the regiment of East and West, rich and poor, caught the imagination of the public, and the Rough Riders, as they were called, became the central feature of the Cuban campaign. The regiment was

credited with an important part in the capture of San Juan Hill and of the city of Santiago.

On his return to the United States, Roosevelt was elected governor of New York. His administration was conspicuous for its integrity, its courage and for certain legislation providing for the taxation of private corporations hitherto exempt. The Ford Franchise Act brought vigorous opposition from the conservative press and was adopted mainly through Roosevelt's personal efforts. Apprehensions of Roosevelt's "radicalism" impelled the leaders of the party in the state to remove him to other fields of activity and, against Roosevelt's own desires, he was nominated (1900) for the vice-presidency on the Republican ticket. On the death of President McKinley, Sept. 14, 1901, Roosevelt became President of the United States.

Roosevelt remained President for seven and one-half years, achieving the presidency "in his own right," as he phrased it, in 1904, after a campaign against Alton B. Parker, the Democratic nominee, which brought Roosevelt the greatest majority which any candidate for the presidency had yet received. His administration conspicuously widened both the powers of the presidential office and the national horizon, bringing a new concentration of power in the Federal Government and an extension of American influence throughout the world, which had a certain invigorating splendor but constituted a departure from established tradition which disquieted observers of an elder generation. The fact was that the turn of the century had ended an era for the American nation both in domestic and foreign affairs. The exuberant individualism of American enterprise following the Civil War had had its flowering and had gone to seed. The Spanish War had established the United States as a world power. These were the fundamental facts of the national situation and Roosevelt's imagination was quick to apprehend them. His administration appeared to the superficial observer a bewildering welter of uncoordinated efforts and conflicts. Actually, it dealt clear-sightedly and consistently with two issues—the stabilization of the American economic system and the consolidation of the position of the United States in the family of nations.

It is important in any examination of Roosevelt's attitude toward economic questions to recognize that he was not a radical but a conservative. He believed unwaveringly in the capitalistic system, but he was convinced that, if it were in the long run to survive, it must adjust itself to changing conditions and recognize the community of interest of producer and consumer and the responsibility of the capitalist, as an individual or as a corporation, to the public whose purchasing power provided the increase on the capitalist's investment. He recognized the peril of a class cleavage between the "haves" and the "have-nots," and all his efforts in the economic field were deliberately aimed to forestall such a cleavage. The obvious first step was to curb the irresponsible individualism of the nation's captains of industry.

The means he employed were four-fold: legislation,

judicial action, executive order and personal persuasion. In the legislative field, he secured the adoption of laws to forbid rebates, to fix railroad rates, to create the Department of Commerce and Labor, to establish the principle of employers' liability, to control the manufacture and sale of adulterated foods and to provide for the inspection of stockyards and packing-houses. In the field of judicial action, he instigated suits against the United States Steel Corporation, the Standard Oil Company, the American Sugar Refining Company, the Northern Securities Company and other powerful corporations. By executive order, pursuing his policy for the conservation of natural resources, Roosevelt increased the national forests from 43 million to 194 million acres, created the Inland Waterways Commission, reserved water-power sites and in other ways supported his contention that the government, acting for the people, must permanently protect the national resources, permitting private interests to develop them only under leases limited in duration. Effective as Roosevelt's efforts were in these directions, his personal influence through speeches and conferences went farther and sank deeper. His personal interposition settled the anthracite coal strike in 1902 and established a precedent for the mediation of the president in industrial disputes as a representative of the public. His speeches, denouncing financial crookedness and pleading for higher standards of business ethics, marked the beginning of a new era in American business.

In foreign affairs, Roosevelt was direct and unhesitating. His adjuration, "Speak softly, but carry a big stick," found expression not only in substantial increases in the Navy but in a foreign policy which not only kept the nation on friendly terms with her neighbors but made her a power in international councils. He protected American nationals in foreign countries, handled the German Emperor with courage and skill in connection with the blockade of Venezuela (1902), effectively if a trifle brusquely settled an old dispute with Great Britain regarding the boundary of Alaska (1903) and brought the Russo-Japanese War to an end (1905). His promptness in recognizing the independence of the republic of Panama (1903) woke the apprehensions of the Latin-American peoples. His despatch of the battleship *Albatross* on a voyage around the world, on the other hand, was unquestionably effective in keeping peace in the Pacific. His personal influence in the construction of the Panama Canal was a powerful factor in the swift completion of the work. He regarded the building of the Canal as his most useful achievement.

Roosevelt refused to be a candidate for the Republican nomination in 1908, lending his influence to his Secretary of War, William H. Taft. He went to Africa immediately on his retirement from office, returning to the United States 14 months later after a year of big game hunting and a triumphal journey through Europe. At the earnest solicitation of the governor of New York, Charles Evans Hughes, he took part in a factional struggle in the Republican

party (1910) and suffered an emphatic defeat. His popularity throughout the country, however, was undiminished. A large element in the Republican party was convinced that his successor had allied himself with the elements in business and politics which Roosevelt had worked successfully to curb, and persuaded Roosevelt against his own better judgment to take the leadership against Taft. In the Republican convention (1912) he was defeated for the presidential nomination by methods which even impartial observers could not defend. He formed the Progressive Party and was nominated as its candidate. At the height of the campaign, he was shot and severely wounded by a maniac while on his way to a public meeting in Milwaukee. His insistence on delivering his speech brought him expressions of admiration even from his opponents. He was defeated in the election by Woodrow Wilson, the Democratic nominee, but received a million more votes than the Republican candidate.

In 1913, Roosevelt undertook a journey of exploration through the Brazilian jungle which permanently impaired his health. At the time of his return, the World War broke out, and he returned to public life as an advocate of a firm foreign policy toward both groups of combatants; and with his friend, General Leonard Wood, organized public opinion in behalf of an adequate national defense. He became an unsparing critic of President Wilson, convinced that the President's vacillating policy was dangerous to the prestige and the safety of the nation.

When the United States entered the War, Roosevelt offered to raise a division of volunteers beyond the draft age, but the President refused the offer. Forbidden to fight in France Roosevelt fought at home with passionate ardor for an effective conduct of the war, and a just and permanent peace. His nomination as the Republican candidate in 1920 appeared assured, when he died suddenly, Jan. 6, 1919.

The bare facts of Roosevelt's life give only a scant impression of the power he exercised for a generation over the American mind. His personality was electric and to most men irresistible. His physical vigor and his astounding memory alike became legendary even during his lifetime. His conversation was ebullient and sparkling with humor; his reactions to opposition or affection were quick and intense. He was a past-master at stage-management, at the dramatic presentation of public issues and of his own personality. He was richly versatile, achieving success not only in statesmanship and politics but in science, in literature, in exploration and on the field of battle. Elihu Root described him as "an almost perfect executive." No man in American history has had a more compelling gift for leadership or one which affected so wide a range of groups and types. He exercised his deepest influence possibly as a moral teacher in behalf of those "pioneer virtues" which he expressed most vividly in his own life and personality. It has been said that the nation Washington created, Jefferson inspired and Lincoln preserved, Roosevelt

revitalized. That his influence, especially on young men, was profound and will continue can scarcely be questioned.

H H.

BIBLIOGRAPHY.—*The Works of Theodore Roosevelt*, Memorial Edition, 24 vols., National Edition, 20 vols., Joseph Bucklin Bishop, *Theodore Roosevelt and His Time*, Corinne Roosevelt Robinson, *My Brother, Theodore Roosevelt*, *Selections from the Correspondence of Theodore Roosevelt and Henry Cabot Lodge*, edited by the latter, Owen Wister, *Roosevelt the Story of a Friendship*, Lewis Einstein, *Roosevelt—His Mind in Action*, Henry F. Pringle, *Roosevelt*, Hermann Hagedorn, *Roosevelt in the Bad Lands*.

ROOSEVELT DAM, located on the Salt River near Phoenix, Ariz., is of arch-gravity, non-overflow type and is constructed of rubble masonry with coursed rubble facing. Its greatest height above foundation level is 280 feet and above the stream bed about 250 feet. The maximum thickness at the base is 158 feet and the top length is 700 feet. The spillways are separate structures at the two ends of the dam. The volume of the dam is 342,000 cubic yards and it creates an irrigation storage reservoir of 71 billion cubic feet capacity.

ROOSEVELT HIGHWAY, a picturesque automobile road of Oregon, extending from Astoria at the mouth of the Columbia River, southward to the California line, a distance of 404.7 mi. The ocean is in sight throughout four-fifths of the way. The surface is paved for 58 mi. and the remainder is bituminous macadam and graded gravel. This is the only highway traversing the Oregon country between the Coast Range Mountains and the sea and it runs through regions formerly almost inaccessible. Along the ocean side of its course are many expansive beaches and opposite there are primitive forests containing varieties of game animals. The advent of the highway has started many developments of vacation resorts. The climate is consistently moderate, snow and ice being unknown and the summer heat being cooled by the sea. Ample rainfall provides a luxuriant vegetation including thickets of rhododendrons and azaleas. Where the land widens into valleys the country is used for grazing lands.

This road was constructed at a cost of about \$16,000,000 as a memorial to Theodore Roosevelt. At Battle Rock a heroic statue of the president will be erected by the American Legion. The highway continues into California where it is known as the Redwood Highway.

ROOT, ELIHU (1845-), American lawyer and statesman, was born in Clinton, N.Y., Feb. 15, 1845. He attended the common schools and graduated from Hamilton College in Clinton, N.Y., 1864. He taught in the Rome (N.Y.) Academy in 1865. In 1867 he graduated from the New York University Law School, was admitted to the bar and began practice in New York City. Appointed by President CHESTER A. ARTHUR, whose personal counsel he was, Root served with distinction as the U.S. attorney for the southern district of New York, March 1883 to July, 1885. He was elected to the New York State Constitutional Convention of 1893, where as chairman of the judiciary

committee he was responsible for the final wording and arrangement of the document.

Root was appointed Secretary of War in WILLIAM MCKINLEY's cabinet, Aug. 1, 1899. He effected a thorough reorganization of the army and established a general staff to coordinate the several divisions of the army (1903). He directed the suppression of the Philippine Insurrection 1899-1900 by the army, and drafted instructions for the Philippine Commission which were subsequently adopted by Congress as a complete civil and criminal code, and a framework of government for the Islands. He similarly drafted a government for Porto Rico. The administration of Cuba was under the direction of the War Department from the Spanish evacuation in 1898 until May 20, 1902 and this delicate responsibility, Root observed diligently with excellent judgment.

In 1902, during the anthracite coal strike, Root was THEODORE ROOSEVELT's intermediary with J. P. MORGAN to induce the latter to bring pressure upon the mine operators to submit the dispute to arbitration. He was a member of the Alaskan Boundary Tribunal which sat in London in 1903. He resigned as Secretary of War, Jan. 31, 1904 to resume his law practice in New York where he was retained by large corporations for many notable cases, including the Northern Securities Case in which he acted for the Morgan-Hill interests. Upon the death of JOHN HAY, he reluctantly abandoned his remunerative and pleasant law practice to accept Roosevelt's appointment as Secretary of State, July 7, 1905.

While on his way in 1906 to the third international conference of American republics he traveled extensively through Central and South America in an effort to allay Latin-American hostility towards the United States which had been aggravated by the Panama Canal incident. He negotiated treaties providing for the settlement of international disputes by arbitration with Great Britain, France, Italy, Spain, Japan and many other nations. It was largely at his insistence that small nations were granted equality with large nations at The Hague Tribunal.

He resigned as Secretary of State, Jan. 22, 1909 and entered the Senate as a Republican, Mar. 4, 1909 for one term after which he declined to be a candidate for reelection, resuming his law practice in New York City in 1915. He was counsel for the United States in the North Atlantic fisheries arbitration at The Hague in 1910. He was elected president of the Carnegie Endowment for International Peace in 1909, and for his work on behalf of international concord, he was awarded the Nobel peace prize in 1912.

Root was appointed by President WOODROW WILSON ambassador extraordinary at the head of a special diplomatic mission from the United States to Russia in 1917. In 1920, he was elected by the League of Nations to the Advisory Committee of Jurists which met to devise a permanent court of international justice. Root's ability was again utilized by the United States when he acted as commissioner plenipotentiary to the Conference on Limitation of Armament at

Washington, D.C., 1921-22. He drafted the reservation for American entry into the World Court, and in 1931 appeared before the Senate Foreign Relations Committee to explain the World Court protocols.

ROOT, GEORGE FREDERICK (1820-96), American music composer, was born at Sheffield, Mass., Aug. 30, 1820. He studied music in Boston and Paris. From 1859 to 1871 he published music in Chicago. His compositions include many popular songs, notably *The Battle-Cry of Freedom*, *Tramp, Tramp, Tramp, the Boys Are Marching*, and *Just Before the Battle, Mother*. He edited several books of sacred music and wrote the cantatas, *The Flower Queen* and *Daniel*. He died at Bailey's Island, Me., Aug. 6, 1896.

ROOT, in music, the tone whence a chord ideally issues. When it is the lowest element of a chord, the bass, the chord is in **FUNDAMENTAL POSITION**; otherwise the chord is an **INVERSION**.

ROOT, in mathematics, is one of the factors of a number which is made up of equal factors. For example, 49 is made up of the equal factors 7 and 7; that is, it is the *square* of 7, and hence 7 is called the *square root* of 49. It is indicated by the symbol $\sqrt{49}$. Similarly we have the cube root of 125, indicated by the symbols $\sqrt[3]{125} = 5$. Speaking more generally, the numbers which make an equation true when they are substituted for the unknown quantity are called the roots of the equation and are said to satisfy it. Every rational integral equation of the n th degree has n roots and only n roots. Thus the equation $ax^n + bx^{n-1} + \dots + jx + k = 0$, where x is not involved irrationally, like \sqrt{x} , and does not appear in the denominator of a fraction, has n roots. In solving the equation $x^2 = 144$, we find the square root of 144; that is, we find one of the two equal factors. The two roots are +12 and -12, since $(+12)^2 = 144$, and $(-12)^2 = 144$. In solving the equation $x^3 = 1$, we find the cube root of 1; that is one of three equal factors. The three cube roots of unity are 1, $-\frac{1}{2} + \frac{1}{2}\sqrt{-3}$, and $-\frac{1}{2} - \frac{1}{2}\sqrt{-3}$, the cube of each being 1. In the same way we can find such higher roots as the fourth, fifth, and so on, of any number. Methods for finding square and cube roots are given in some arithmetics and in all elementary algebras. They have little practical value, roots of any degree being easily found by means of logarithms and, in case of square and cube roots, from tables of roots. See **LOGARITHM**; **POWER**; **RADICAL**; **EQUATION**.

ROOT, usually an underground organ of plants associated with absorption of water and mineral materials and with anchorage in the soil. There is much variation in size and depth of penetration. Roots develop either tap or fibrous systems depending on whether the primary root persists as the prominent member or is replaced by numerous secondary branches. Examination of an individual root shows certain regions, a conical root-cap, a short growing zone, a region producing root-hairs and an older por-

tion where root-hairs have died. The short-lived root-hairs, each a fine tubular outgrowth from a single cell of the surface epidermis, increase the absorbing power of the root many fold through the larger surface in contact with water films on soil particles. In cross section a root shows tissues differentiated from the cells formed in the growing zone, as in stems, but in different arrangement. Within the epidermis and cortex, the vascular tissue is central rather than scattered or arranged about a pith; small strands of phloem alternate with arms of xylem radiating from a central core of xylem or wood. An active cambium lying between these conducting layers increases the diameter by producing new wood on its inner face and new phloem on its outer. Enough new wood may be formed to produce a cylindrical rather than a radial effect. The root may then still be distinguished from most stems by the lack of pith and by the mode of origin of new side roots which arise at the surface of the vascular cylinder. These lateral roots must penetrate the cortex before reaching the surface. Stems branch by the formation of buds at the surface, usually just above the point of attachment of a leaf.

N. E. P.

ROOT CROPS, for animal feeding. See **ROUGH-AGES**.

ROOT CUTTERS. See **CUTTERS**, **AGRICULTURAL**.

ROOT-TAKAHIRA NOTES, the notes exchanged between the United States and Japan Nov. 30, 1908. The notes pledged mutual respect for territorial possessions, stated that the nations would support by all peaceful means China's territorial integrity and the principle of equality of opportunity in China, and provided that in case of a possible violation of China's rights or of the "open door" principle Japan and the United States should consult on what steps to take. Japan had exchanged similar notes with France and Russia earlier in the year.

ROOZEBOOM, HENDRICK WILLEM BAK-HUIS (1854-1907), Dutch physical chemist, was born at Alkmaar, on Oct. 24, 1854. After studying at Leiden, he became professor of chemistry at Amsterdam in 1896, and was one of the first to grasp the significance of the Phase Rule derived by Willard Gibbs. Using it, he made extensive researches in the problems of freezing and boiling points, and equilibrium of mixtures of solids, liquids and gases. These he began to publish in 1904 in what was to have been his great work: *Die Heterogene Gleichgewichte vom Standpunkte der Phasenlehre*. He died, Feb. 8, 1907, and the series of monographs was finished by his pupils in 1918.

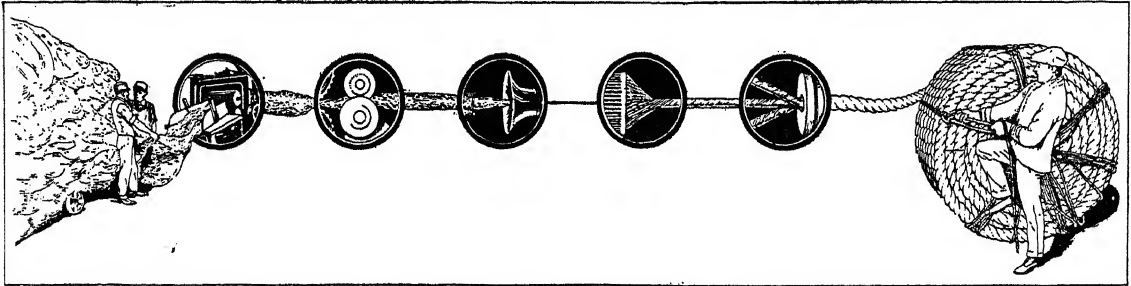
ROPE. **CORDAGE** exceeding one inch in circumference. Ropes are made of hard fibers such as manila, sisal, maguey phormium or coir, of soft fibers as cotton, hemp or European hemp, or of wire when great strength is required. Were a rope to be formed by simply twisting together in one direction the whole of the fibers of which it is composed there would be nothing to prevent its untwisting as soon as left to itself. It is necessary therefore to twist the

fibers in comparatively small portions, and so to combine these into a rope that the tendency to untwist in one part may counteract the like tendency in another. Thus the same force which would cause the component parts to separate and untwist is employed, when they are combined in a rope, to keep the whole firm and compact.

In making cordage of very large size it is usual to employ the cabling method, forming a cable com-

ing a wheelbarrow, and walking on stilts. Wire walking is an offshoot of rope walking, and performers on a steel strand frequent the music hall, vaudeville theater and the circus.

ROPEWAYS AND CABLEWAYS, ropes or cables suspended between two points and used for supporting carriers. They are used in industry for conveying all kinds of materials, as ores, lumber, grain or liquids, over comparatively short distances.



COURTESY COLUMBIAN ROPE CO.

STEPS IN THE MANUFACTURE OF MANILA ROPE

At extreme left is loose manila fiber just removed from bales. This fiber is passed through a machine, known as a breaker, in which steel hackle pins on an endless chain comb and parallel the fibers. The fiber leaves the breaker in a continuous ribbon, called a sliver. The sliver passes through a series of machines where it receives additional combing and is reduced to a more compact fiber. The fourth step shows the spinning jenny where the slivers of fiber are drawn through fine hackle combs, twisted into yarn and wound on spools or bobbins. In the next step, the proper number of bobbins are placed on a rack and the yarns are drawn through a guide and twisted into one strand. Three or four of these strands are then twisted into the completed rope, which is made into coils and tied in the final step.

posed of smaller ropes twisted together as if they were the strands of an ordinary rope. Cable-laid ropes are harder and more compact and well adapted to exposure to water. Modern rope works, equipped with "house" machines, are rapidly superseding the old-fashioned rope walks where hand machines are still employed.

C. R. C.

BIBLIOGRAPHY.—H. R. Carter, *Rope, Twine and Thread-making*.

ROPE DRIVE, a method of power transmission in which ropes are used in place of belting. See **BELTING**.

ROPE WALKING, the act of walking upon a rope, suspended between two supports, was a feat common to Greek and Roman entertainments. Since ancient times there have been countless records of tight-rope performers. One such account describes the feats of a Moorish troupe, which in the 13th century strung ropes for walking between the swaying masts of ships in Italian and Spanish ports. Rope walking requires a delicate sense of balance and a sure foot, but it is not generally considered the highest development of acrobatic skill. Nevertheless the spectacular nature of the art arouses the breathless admiration of the layman.

The measures to which rope walkers have resorted to provide a novel performance deserve mention. In the time of Charles VI of France, a performer in Paris walked over a rope stretched between the bridge of St. Michael and the Cathedral of Notre Dame, carrying two small boys. On June 30, 1859, Charles Blondin, a French acrobat known as The Little Wonder, crossed Niagara Falls on a rope, making the journey in five minutes. In three subsequent performances over the falls, he crossed blindfolded, push-

Ropeway and cableway systems consist, essentially, of two terminals at which the material is handled, a heavy wire rope or ropes suspending the carrier, a wheeled carrier which travels along the track, and a separate rope which propels or controls the carrier as it is power or gravity operated. These systems may be continuous, where a number of carriers make a continuous circuit; or one or two carriers may move forward and backward, each on its individual rope. In the continuous type the carriers may be attached to the traction rope permanently or by a releasable friction grip. When attached permanently, they must receive and discharge their load while in motion.

ROQUE, an outdoor game played on a lawn or earth court, with mallets and balls. In the United States to-day, roque is very similar to **CROQUET**. Some of the differences are: on some courts the corners of the rectangle are cut off and cushioned; the mallets are shorter; the 10 arches are sometimes smaller, and in consequence more difficult to pass through than in croquet; and carom shots are permissible. In 1899 a few enthusiasts of the game of croquet made the game more scientific in several respects, so that the sport required almost the accuracy of a billiard player. The name roque was adopted for this variation, to distinguish it from croquet.

ROQUEFORT-SUR-SOULZON, a small town in the Cevennes Mountains, southern France. It is famous for its cheese, of which the estimated annual production is about 20,000,000 lbs. Pop. 1931, 1,495.

RORAIMA FALLS, waterfalls in the Roraima Mountains, situated on the boundary between British Guiana, Venezuela and Brazil. The falls are over the

giant table mountain of sandstone rock, and are the sources of streams flowing into the Orinoco, Amazon and Essequibo. The waters drop from steep rocky walls 3,000 ft. high. On the top are innumerable little channels ranging from 2 to 6 ft. in depth. During the rains these lakelets overflow and are discharged over the rim of this largest if not loftiest of all table mounts, falling as spray. The top is still beyond the range of tourists and is visited only by explorers and orchid hunters.

RORDAM, VALDEMAR (1872-), Danish poet, was born at Stage, Sept. 23, 1872. His first book of verse, *Sun and Cloud*, was issued in 1895. A year later he had a breakdown, and while confined to his bed wrote the epos, *Beowulf*. The generosity of friends and admirers enabled him to go to the Schwartzwald and Italy, where he completely regained health. Rordam is preeminently a lyric poet, and the best of his work is probably to be found in *Selected Poems of Twenty Years*, *The Old Parsonage*, *Small Town Idyls*, *Across the Indian Ocean*, *Bird Songs* and *Flower Verses*.

RORQUAL, a large whale of the genus *Balenoptera*. To this group belong some of the largest of the whalebone whales; they are distinguished from right whales by having a dorsal fin and numerous ventral furrows and are commonly called finback whales. Well-known species are the common rorqual (*B. physalus*) exceeding 70 ft. in length, and the pollack whale (*B. borealis*). Rorquals are found in all oceans, and are very valuable catches. See also WHALE.

RORSCHACH, an old port of Switzerland on Lake Constance in the canton of St. Gall. It is a railroad center and has steamboat connection with all the other ports on the lake. It is industrially important, the chief products being organs, pianos, tulle, embroidered articles and machines. There is also a heavy grain trade and most tourists enter Switzerland at this point. Pop. 1930, 10,972.

ROSALIE, MOUNT, a summit in the Front range of the Rocky Mountains in Colorado. It is part of the Mt. Evans group consisting of Mt. Evans, Mt. Bierstadt and Mt. Rosalie. The first two have altitudes exceeding 14,000 ft. and Rosalie reaches 13,574 ft. All three peaks were at various times called Rosa, Rosalia or Rosalie because of their color under certain conditions. Mt. Evans was definitely named in 1870 and Bierstadt in 1914.

ROSARIO, a city of Argentina, on the Parana River about 180 mi. northwest of Buenos Aires. The importance of Rosario as a commercial city is due to General Urquiza, who made it a port of entry in 1859. Ocean steamers drawing 28 ft. come to its docks. Situated in the great cereal section, the port has taken over the exporting of most of Argentina's wheat, corn and flaxseed, its inhabitants depending to a large extent on this trade. Five railroad systems connect the port with the surrounding country and deliver to it over 3,000,000 tons of export yearly.

The city is well planned, with parks, large public

and business buildings, electric lights, street-car lines and many flourishing industries, the principal being large sugar refineries, flour mills and breweries. Rosario was founded by Francisco Godoy in 1730, but progressed slowly until the middle of the 19th century. Est. pop 1930, 470,000.

ROSARY (Latin *Rosarium*) of the Blessed Virgin Mary, a string of beads according to which the Lord's Prayer and the Hail Mary are prayed with changing additions. "Rosary" also designates the form of prayer, consisting of 15 decades of Hail Marys, each decade preceded by an Our Father, followed by a Gloria, said audibly or silently while meditating on the life, death and resurrection of the Lord. This rosary is sometimes called the Dominican, because its origin is attributed to St. Dominic, but in reality the chief propagator of this form of prayer was the Dominican monk Alarius de Rupe (de la Roche), who died in 1475. The Rosary has been indulgenced by many of the popes and Pope Leo XIII chose October as the Month of the Holy Rosary. The rosary as a prayer-string of beads was used by the Buddhists. Hermits and monks in very early times used little stones to count their prayers and psalms. In place of the Psalms, a number of Our Fathers and Hail Marys were later said. The Mohammedans use a rosary (*Tesbih*) of 99 beads while pronouncing the 99 attributes of God.

ROSAS, JUAN MANUEL DE (1793-1877), Argentine dictator, born in Buenos Aires in 1793 of distinguished Spanish creole family. He fought against the British invaders in 1806 and 1807, for several years managed his father's ranch, but falling out with his family, engaged in ranching and the salt beef industry on his own and acquired a large fortune. In 1820, as commander of a cowboy militia, he assisted in repressing the anarchy that was desolating Buenos Aires, and in 1829, after a civil war, was elected governor for three years and captain general of the province. In 1835 he was chosen dictator. Until 1852 Rosas governed the destinies of Buenos Aires directly and indirectly those of the other provinces of the Argentine Confederation. His régime was relatively peaceful and prosperous. Rosas successfully defended the interests of Argentina against the French who blockaded Buenos Aires in 1838-40, and against the French and English who were at war with him in 1845-48. He was finally overthrown by General Jose de Justo Urquiza, who, in alliance with Brazil and Uruguay, defeated him in 1852. Rosas went to England with his daughter, where he lived in poverty until his death in 1877.

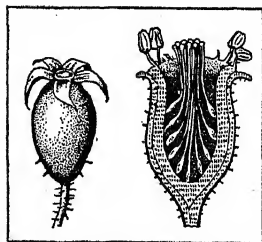
ROSCOMMON, WENTWORTH DILLON, 4th EARL OF (c. 1630-1685), English poet, was born in Ireland about 1630, and educated at Caen, Normandy, and at Rome. Among his works are *Horace's Art of Poetry Translated into English Blank Verse*, *Essay on Translated Verse*, 1684, and a translation of *Dies Irae*. His writings were praised by Alexander Pope for their purity of diction. The poet was buried Jan. 21, 1685, in Westminster Abbey.

ROSE, WICKLIFFE (1862-1931), American educator, was born in Saulsbury, Tenn., Nov. 19, 1862. He was graduated from the University of Nashville in 1889 and took his M.A. there in 1890, and in Harvard in 1913. From 1891-1907, he was connected with the faculties of Peabody College, University of Nashville and University of Tennessee. He served as general agent of the Peabody Education Fund from 1907-15, and has held various important educational and administrative positions. Rose was a member of the Rockefeller Foundation, 1913-28; of the International Health Board, 1913-28, and its general director, 1913-23; of the General Education Board, 1911-28, and its president, 1923-28; and was president of the International Education Board, 1923-28. He died at Vancouver, Canada, Sept. 6, 1931.

ROSE, the type genus of the ROSE FAMILY (*Rosa*, ancient Latin name), consisting of usually spiny or prickly shrubs. Though one botanist has described 4,266 European and Asiatic species and another has reduced those of the whole world to only 30, most authorities recognize about 100 species. These are natives of the temperate parts of the Northern Hemisphere as far south as the colder elevations of Mexico, Abyssinia and India.

For centuries various species have been grown in gardens for their attractive foliage and ornamental fruits but still more for their handsome, often fragrant flowers which range in color from white to deep red and yellow but not to blue.

Attar of roses, a highly fragrant essential oil, is made from the flowers of two species (*Rosa damascena* and



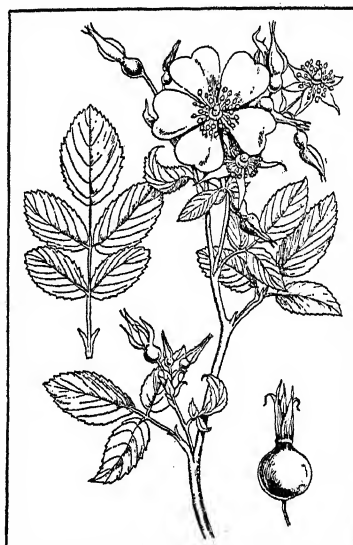
ROSE HIP

R. alba) mainly in south-eastern Europe and western Asia and the large fruits of a few species, especially *R. canina* and *R. pomifera* are used for making conserves but roses are of small economic consequence in comparison with their value as ornaments. In this rôle no other flower has a longer history or is more widely grown. Love of the rose traces back through poetry and song to the literature of the ancient Aryans, yet it has played only a small part in China and Japan. Because of its almost prehistoric popularity it is presumed to be the first plant to have produced double flowers. This characteristic and that of the intercrossing of species have given rise to the thousands of named varieties listed by nurserymen. Natural species and single rose varieties have a grace and charm which make them especially desirable for mass planting in parks and naturalistic gardens.

In general, however, garden roses naturally form two classes, those that blossom only once each year, usually in early summer, and those that blossom more or less continuously, but much more sparsely, during the summer and autumn, even until the close approach of winter. To the former class belong such well-

known groups as moss, Provence, China and Bourbon roses and the various briars; to the latter class, many hybrids of these and other kinds as well as *Rosa rugosa*, *R. lucida*, *R. Wichuraiana* and other species and their hybrids.

In the United States and Canada some 20 native species of rose are found, widely distributed throughout the continent. Representative of these wild roses



FROM JEPSON, MAN. FL. PLANTS CALIF., COPYRIGHT

CALIFORNIA WILD ROSE

Leaf, flowering branchlet and fruit

are the smooth or meadow rose (*Rosa blanda*), the prairie rose (*R. setigera*), the swamp rose (*R. carolina*), the pasture rose (*R. virginiana*), and the California rose (*R. californica*).

Although less than a score of species are the progenitors of the large flowered cutting roses, three or four times as many species excel them and their varieties for landscape planting purposes. Conspicuous among these are *Rosa rugosa*, an oriental species which forms very leafy bushes, bears large, single white, red or pink flowers and makes excellent blooming hedges; *R. setigera*, the American prairie rose, a good climber with deep rose-colored flowers which fade to white; *R. lavigata*, or Cherokee rose, a tall Japanese shrub with fragrant white or pink flowers;



RUGOSA OR JAPANESE ROSE

Rosa rugosa

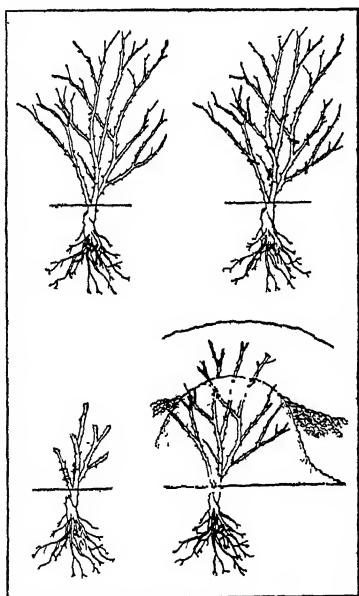
and *R. Wichuraiana*, or memorial rose, with little, fragrant, white flowers and especially useful as a ground cover among rocks. All of these have produced hybrids of even greater value than themselves.

Not only is the rose the most popularly cultivated flower of the world but in America it is the leading commercial plant grown under glass. The money in-

vested in greenhouses devoted to its cultivation and that annually spent for its flowers totals many millions of dollars. Since the introduction of free blooming varieties adapted to this branch of floriculture the flower has come within the means of the great majority of the people. The popular demand for flowers has been fostered also by winter exhibitions in many cities and by the spring, summer and autumn shows of garden clubs and other organizations.

The American Rose Society, founded in 1899, has stimulated general interest in the cultivation, and become the great clearing house of information regarding this flower, especially through its *Rose Annual*, a book of more than 200 pages full of the latest developments in rose culture and varieties. The society has also established test gardens in Washington, D.C., Minneapolis, Minn., Hartford, Conn., and at Cornell University, Ithaca, N.Y., where five or more plants of each variety being tested are grown under uniform conditions, inspected and reported upon annually by committees of the society.

Seeds of many rose species are sown by nurserymen to get plants. They are also used by plant breeders after having crossed both species and established varieties to develop new kinds. Nature occasionally presents new varieties as sports or bud variations on plants that normally bear different types of flowers. These and other commercial supplies of plants are propagated by cuttings, grafting or budding. In a



COURTESY WAYSIDE GARDENS CO

THE CULTIVATION OF ROSES

Reading left to right: (1) Depth at which to plant. (2) Black cross lines show where to prune. (3) (lower left) Properly pruned in spring. (4) Hilled up, covered a little, and covered in fall for winter protection. Soil and leaf covering shown.

small way layers of flexible stemmed kinds are often used in gardens to get a few plants. "Division" is also practiced with several species and varieties that produce suckers from their bases or their roots.

In gardens, roses may be successfully grown in any soil that will produce good grass or vegetables but best results are obtained in well-drained, deep, rich loam. By the imitation of such natural conditions through the addition of sand, vegetable matter and plant food, even heavy clays may be made into good rose soil. Full sunshine for at least half the day is essential to success with most species and varieties. A favorite and convenient bed is 4 ft. wide and any desired length with two staggered rows of plants 30 in. apart and set one foot back from the edges. Thus every plant gets ample sun and air and does not interfere with its neighbor and the flowers may be gathered without tramping on the bed. Moisture must be maintained by cultivation, by abundant vegetable matter in the soil or by surface mulches.

Pruning is a more important factor of success with roses than with any other shrub. Two primary points to be considered are the class to which each variety belongs and the result desired. In this second case severe cutting, reducing the stems to only two or three of the strongest and these to only two or three buds each will produce small bushes, but long stemmed, large and perfect flowers; moderate cutting will increase the size of the bushes and the number of blooms but reduce the size and perfection of the flowers; light cutting will favor still larger bushes and increase the number but reduce the size of flowers.

Before doing any cutting it is necessary to know the class to which the individual plant belongs. This may be determined by knowing the name of the variety and consulting a rose variety catalogue. All weak and dead wood should be cut out, only strong stems left and these shortened according to the desired end, large and few, or many and small flowers. Moss roses, polyanthas or "baby rambles," teas and hybrid teas should be pruned just as the buds begin to swell in spring; hybrid perpetuals and Austrian briars in early spring; hardy climbers, pillars and rambles immediately after flowering by removing old wood either at the ground or the main trunk so as to stimulate the production of new wood for the following season's flowers. Rugosas and their hybrids and sweet briars need little pruning other than to remove stems older than two or three years and to maintain the good form of the bushes.

Cutting the flowers is equivalent to pruning. When most of the flowers of everblooming kinds have been cut with long stems, the plants will not need the supplementary pruning that should follow the first blooming period each year.

M. G. K.

ROSEBAY, a name often given in the United States to various species of RHODODENDRON, especially



POLYANTHUS ROSE

Often called the Baby Rambler

to the great laurel (*R. maximum*) and the Catawba laurel (*R. catawbiense*), both highly ornamental flowering shrubs with many varieties and hybrids in cultivation.

ROSE CHAFER, a slender, yellowish, long legged beetle (*family Scarabæidae*) which in early summer attacks many flowers and fruits. Often it comes in such hordes that flowers are destroyed, plants killed or crops ruined. Eggs are laid in grassy or weedy ground where the soil is sandy. The young feed on grass and weed roots and emerge the following year. Plowing such fields in early fall and keeping them bare will starve the grubs; spraying with lead arsenate and molasses in water will kill the adults. Bare ground during the breeding season will make them migrate.

ROSE FAMILY, a numerous natural group (*Rosaceæ*) comprising, as customarily regarded, about 2,500 species of trees, shrubs and herbs distributed in all parts of the world. It contains many of the most important fruits grown in temperate regions and an immense number of ornamental shrubs, trees and garden flowers. Among the fruits produced by plants of this family are the apple, peach, almond, apricot, pear, cherry, plum, quince, strawberry, blackberry and raspberry. Among the ornamentals included in the family are innumerable varieties of roses, spireas, the flowering almond, Japanese cherry, mountain ash and hawthorne.

Some botanists divide this group into three plant families: (1) the apple family (*Malaceæ*), producing pome fruits; (2) the peach family (*Amygdalaceæ* or *Prunaceæ*), producing stone fruits; (3) the rose family proper (*Rosaceæ*), producing usually dry or berry-like fruits. See also *Rose* and articles on the various plants mentioned.

ROSELLE, a borough of Union Co., N.J., adjoining Elizabeth on the east and Roselle Park on the north. It is served by the Central of New Jersey and the Baltimore and Ohio railroads and numerous motor bus lines. Roselle is a residential community for workers in New York City and the Elizabeth industrial district. The retail trade in 1929 amounted to \$5,102,302. Pop. 1920, 5,737; 1930, 13,021.

ROSELLE PARK, a borough of Union Co., N.J., contiguous with Elizabeth, N.J., to the east and Roselle, N.J., to the south, located 16 mi. southwest of New York City. It is served by the Central of New Jersey, Lehigh Valley and Rahway Valley railroads, electric trolleys and motor bus lines. It is a residential community, being a popular suburb for New York and Newark business men. It was one of the first communities in the United States to be lighted by electricity. Pop. 1920, 5,438; 1930, 8,969.

ROSEMARY (*Rosmarinus officinalis*), an evergreen shrub of the heath family, native to Mediterranean countries and commonly cultivated in gardens. It grows 2 to 4 ft. high bearing thick linear leaves with their margins rolled backwards and small two-lipped flowers in short axillary clusters. The aromatic leaves, which have a warm pungent bitterish taste, are used

as a seasoning and yield a fragrant volatile oil employed in perfumery.

ROSENKAVALIER, DER, an opera in three acts by RICHARD STRAUSS, libretto by Hugo von Hofmannsthal; première, Dresden, 1911, London and New York, 1913. It is the most popular of Strauss's several operas, and has secured a reasonably firm foothold in the standard repertory. Although the score calls for an immense orchestra, like virtually all the composer's works, the treatment is jocose rather than ponderous, abounding in waltzes and gaiety.

Although long married to a field-marshal, the Princess von Werdenberg is sufficiently charming to attract a handsome youth named Octavian. Between them a love affair soon develops. Just as Octavian is about to take his leave of the countess, one morning, Baron Ochs von Lerchenan calls to see her. To avoid a scandal, Octavian hides and dresses himself as a chambermaid. Meanwhile von Lerchenan states his mission. Has the princess yet fulfilled her promise of sending a Knight of the Rose to Sophie von Faninal, bearing the baron's offer of marriage? Alas, the princess has been much too occupied to send a proxy for the baron, who is accordingly annoyed. At this point Octavian emerges as a pretty maid. Immediately von Lerchenan's attention is diverted, and he is soon making a rendezvous with the disguised Octavian who, when the baron has gone, is selected by the princess as his emissary, bearing Sophie a silver rose emblematic of her suitor's fidelity. However, no sooner does Octavian meet Sophie than he is smitten by her, while she in turn prefers the handsome Knight of the Rose to the stupid baron. High words between Octavian and von Lerchenan follow. The former contrives to discomfit the latter by bringing forth a woman who claims to be the deserted wife of the baron; and after several alarms and excursions, Princess von Werdenberg arrives on the scene. Appraising the situation, she leaves Sophie and Octavian to the inevitable, and drives off with the flustered baron.

ROSENWALD, JULIUS (1862-1932), American merchant and philanthropist, born at Springfield, Ill., Aug. 2, 1862. After a public-school education, he entered the mercantile business in New York City in 1879. He went to Chicago in 1885, and was senior partner of a clothing manufacturing firm until 1895, when he became vice-president and treasurer of Sears, Roebuck & Co. He served as president of Sears, Roebuck & Co. from 1910 to 1925 and afterwards as chairman of the board. In 1916, he was appointed a member of the Council of National Defense Advisory Committee and chairman of the Commission of Supplies. His gifts to Jewish and Negro educational and civic organizations, including the JULIUS ROSENWALD FOUNDATION, were estimated in 1930 to amount to between forty and fifty million dollars. He died Jan. 7, 1932. His estate was valued at \$20,000,000.

ROSE OF SHARON (*Hibiscus syriacus*), a hardy shrub of the mallow family, called also shrubby althea. It is a native of eastern Asia widely cultivated in nu-

merous varieties. The smooth erect stem, sometimes almost treelike, bears triangular, somewhat lobed, strongly three-ribbed leaves and large, bell-shaped, often double, rose, purple, bluish or white flowers. The shrub is suitable for hedges, responding readily to topiary treatment.

ROSE POLYTECHNIC INSTITUTE, at Terre Haute, Ind., a privately controlled, non-sectarian, technological college for men incorporated in 1874. It was named in honor of its benefactor, Chauncey Rose, and was opened Mar. 7, 1883. Courses are offered in the various branches of engineering, and in architecture and chemistry. Practical work in the shops is an important feature of the institution. It had productive funds in 1931 amounting to \$1,535,770. The library contained 16,000 volumes. In 1930-31 the student enrollment was 325, and the faculty of 22 was headed by John White, acting president.

ROSEROOT (*Sedum roseum*), a low fleshy perennial of the orpine family planted for ornament in rock gardens. It is found around the world in arctic regions and also on mountains in the temperate zone; in North America it extends southward to New York and Pennsylvania. The erect unbranched stems, rising from a thick rose-scented rootstock, bear oblong sessile leaves and yellow or sometimes purplish flowers in a terminal, flat-topped cluster.

ROSES, WARS OF THE, a period of internecine strife in the second half of the 15th century between the adherents of the Lancastrian dynasty and the Yorkists. The name is derived from the tradition that the white rose was the badge of York, and the red rose the badge of Lancaster; a tradition that is true only in regard to the Yorkists. The struggle originated not as a contest for the crown but as a protest against the inefficiency and misgovernment of Henry VI and his advisers. In 1450 Richard, Duke of York, assumed leadership of the opposition. He was descended by both his father and mother from Edward III and so long as Henry VI was childless, Richard was heir-presumptive to the throne. In Aug. 1453 the King became insane. Were this incapacity permanent, Richard would be regent and would, on Henry's death, succeed to the throne; but affairs became complicated when, two months later, the queen gave birth to a son and asserted her right to the regency. Parliament in Feb. 1454 appointed Richard Protector and Defender of the Realm, a position which he filled with ability and moderation until at the end of the year the King recovered his reason. The Yorkists were then removed from office, and Richard found it necessary to take to arms.

In a street fight called the first battle of St. Albans, May 22, 1455, the King was taken prisoner and the Yorkists resumed office. But the Queen soon regained the ascendancy and her policies brought about a renewal of hostilities in 1459. Richard then fled from England. He returned the next year, defeated the Lancastrians at Northampton, and laid claim to the throne. A compromise was reached: he should succeed to the throne after Henry's death. The Queen

raised an army; Richard was defeated and killed at Wakefield; his followers were again beaten in the second battle of St. Albans. Richard's son, Edward, inflicted a decisive defeat on the Lancastrians, occupied London, and ascended the throne in 1461 as Edward IV. Peace was not fully restored for three years. Later a rebellion temporarily ousted Edward in 1470, and for a few months Henry VI was restored. The wars came to an end with Edward's victory at Tewkesbury, May 4, 1471. A. H. S.

ROSE THEATRE, a popular Elizabethan theater, on the Bankside, Southwark, London, managed by Philip Henslowe from 1592 till 1603.

ROSETTA, a well built and attractive city of Egypt, 30 mi. west of Alexandria. Although situated on a branch of the Nile, the town does not accommodate large shipping, as the river is badly silted. A large transit trade once passed through Rosetta, but this has now been almost entirely diverted to Alexandria. Near the city the famous **ROSETTA STONE** was discovered in 1799. Pop. 1927, 23,048.

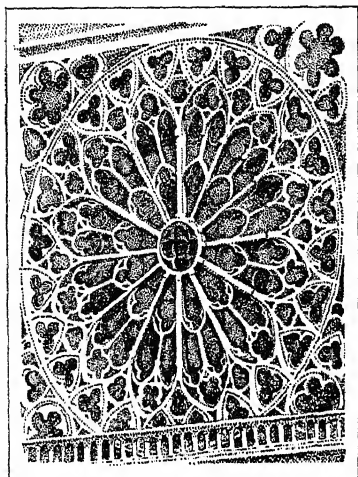
ROSETTA STONE, the key by which the Egyptian hieroglyphic writing (*see* **HIEROGLYPHICS**) was deciphered. It is a black basalt slab containing an inscription made in 196 B.C., in the form of a resolution of gratitude to Ptolemy Epiphanes, King of Egypt, for services rendered to the priesthood, and is written in triplicate in three languages, Egyptian hieroglyphic and demotic and Greek. An engineer in Napoleon's Egyptian expedition of 1799 discovered it near Rosetta, in the Delta. Immediately it was examined with a view to decoding the hieroglyphs. The form for the word king had been previously deduced by Zoëga from other inscriptions, and it was regarded as certain, from the Greek duplicate, that a certain combination spelled the name of Ptolemy; but this clue was of no assistance, due to an erroneous idea of the nature of hieroglyphs. Champollion, a French Egyptologist, suspected almost intuitively the real phonetic character of these symbols, and by 1822 had made a definite beginning. In 1880 the first hieroglyphic-demotic dictionary was brought out in Germany.

ROSEVILLE, a city in Placer Co., northern California, 18 mi. northeast of Sacramento, served by buses and the Southern Pacific Railroad. There is an emergency landing field. Flowers and fruit, especially grapes, are grown extensively in this district. The large railroad shops of the Southern Pacific, the icing plant of the Pacific Fruit Express Co., and sand and rock pits afford the chief industrial activities. Roseville, built on the lower foothills of the Sierra Nevada Mountains, was incorporated in 1909. Pop. 1920, 4,477; 1930, 6,425.

ROSEVILLE, a residential city and suburb of Detroit, 14 mi. northeast of that city. It is situated in Macomb Co., southeastern Michigan. Fruit and truck farming are the leading agricultural interests. Pop. 1930, 6,836.

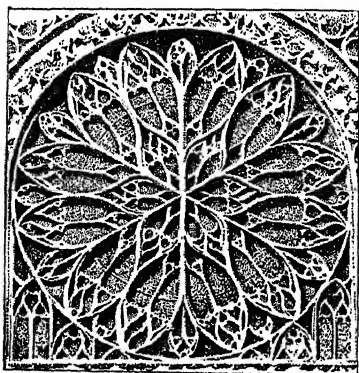
ROSE WINDOW, a circular window decorated with **TRACERY**. The circular window was first developed in Romanesque architecture for the lighting

of a church nave through its end wall over the main western door. The French builders of the 12th century made it increasingly large, until in the early Gothic period, as in the west front of Chartres, it



ROSE WINDOW, SOUTH TRANSEPT OF
NOTRE DAME, PARIS

occupied the greater portion of the end of the nave. A similar form was almost necessarily used in the transept walls. In Chartres, the tracery is plate tracery, that is, almost a continuation of the wall face, pierced with carefully arranged openings, circular and cusped. With the development of bar tracery, towards the middle of the 13th century, rose windows became much more open, with rich radiating designs. The three roses of Notre Dame in Paris are typical. With the flamboyant period, the intricacy of curved line confused the radiating pattern, though possessing a



FLAMBOYANT ROSE WINDOW IN THE
SOUTH TRANSEPT OF AMIENS CATHEDRAL

complex grace of its own. In Italy a variant form, in which the radiating spokes are treated like colonnettes, complete with capital and base, was the accepted type.

ROSEWOOD, the commercial name of a valuable cabinet wood obtained from various South American trees but chiefly from cabiuna or jacaranda (*Dalbergia nigra*), a large Brazilian tree of the pea family. Rose-

wood varies in color from ruddy brown to purple, beautifully streaked and grained with dark red and black layers. Though somewhat difficult to work, it takes a high polish and is extensively used for making furniture and musical instruments and also for veneering. The timber of various other tropical trees found in Africa, India and Australia is also known as rosewood.

ROSIN, or **COLOPHONY**, the residue which remains after the volatile oil of turpentine has been driven off by distillation from the **OLEORESIN** which exudes from cuts made in pine trees. It consists mainly of **ABIETIC ACID**, and varies in color from pale amber to dark red-brown. Rosin is a brittle solid with a glassy fracture, specific gravity 1.07 to 1.08, soluble in ether, chloroform, acetone, alcohol, benzene, glacial acetic acid and fixed oils. Rosin dissolves in alkalis to form an ingredient of many common soaps; it softens at about 80° C. and melts at 100° to 135° C. Rosin may be distilled in a current of steam above 200° C., but on ordinary distillation rosin oil, used in lubricating grease, is obtained.

Rosin is employed in some common varnishes. If combined with certain metals it forms resinates, which are used as driers in paint and varnish. Soluble salts of rosin are used widely in paper sizing. Combined with glycerine to form the ester known as ester gum, rosin forms a constituent of enamels, varnishes and nitrocellulose lacquers. Rosin is also used in sealing wax and to seal dry batteries.

An important source of rosin is dead pine wood, which is chipped, steamed to remove the oil of turpentine and pine oil, and the chips are then heated with gasoline to extract the rosin. The gasoline is recovered for re-use, leaving so-called wood-rosin, which has a dark red color, but which can be purified to the palest grades or even to abietic acid. *See also* **WOOD DISTILLATION**; **RESINS, NATURAL**. E. M. SY.

BIBLIOGRAPHY.—Barry, Drumm and Morrel, *Natural and Synthetic Resins*, New York, 1926.

ROSINWEED (*Silphium laciniatum*), a tall rough-hairy perennial of the composite family known also as **COMPASS PLANT**. All parts of the plant abound in a resinous juice exuding from the stem and flowering branches in clear droplets which, after exposure to the air, are transformed into a whitish gummy substance. The **GUM PLANT** (*Grindelia squarrosa*), of the western United States, is sometimes called rosinweed.

ROSS, BETSY (1752-1836), the seamstress who made the first American flag, was born at Philadelphia, Pa., in 1752. When she was twenty-five George Washington and other members of a committee commissioned her to make the national flag chosen by the Continental Congress. The committee adopted her suggestion that five- instead of six-pointed stars be used. Betsy Ross's work met such approval that she received a contract to furnish all the flags for the government. After her death in 1836 the business was carried on for twenty years by her daughter.

ROSS, SIR JAMES CLARK (1800-62), British navigator, rear admiral and Arctic and Antarctic ex-

plorer, born in London, Apr. 14, 1800. In 1818, he sailed with his uncle, Sir John Ross, in search of a north-west passage and again in 1829-33, when he discovered the position of the north magnetic pole. He also accompanied Parry on four Arctic expeditions. He led an Antarctic expedition from 1839 to 1843 and discovered Victoria Land. In 1848 he headed the expedition in search of Sir John Franklin. He died at Aylesbury, England, Apr. 3, 1862.

ROSS, SIR RONALD (1857-), British physician and bacteriologist, born at Almora, India, May 13, 1857. He studied medicine at St. Bartholomew's Hospital, London, and in 1881 entered the Indian medical service. In 1902, he received the Nobel prize in medicine. Ross discovered the fact that the Anopheles mosquitoes transmit malaria. He possessed unusual ability in mathematics and is credited with founding a new science known as pathometry. Ross was editor of *Science Progress* and contributed several volumes on malaria. M. F.

ROSSETTI, CHRISTINA GEORGINA (1830-94), English poet, was born in London, Dec. 5, 1830, the daughter of an exiled Italian patriot, and the sister of DANTE GABRIEL ROSSETTI. Her life was outwardly uneventful. A precocious child, she wrote poems at the age of 11, published *Verses* in her 17th year, and at 20 was a contributor to *The Germ*, a noted Pre-Raphaelite magazine. She enjoyed the friendship of such eminent Pre-Raphaelite artists as Holman Hunt, Burne-Jones and William Morris, and in her youth, when she was famed for her beauty, posed for many of their paintings. In her latter years the poet suffered from an incurable disease. She died in London, Dec. 29, 1894.

Christina Rossetti's finest poetry is contained in *Goblin Market and Other Poems*, 1862, *The Prince's Progress and Other Poems*, 1866, *The Pageant and Other Poems*, 1888, and *New Poems*, posthumously issued in 1896. She also published *Sing-Song: A Nursery Rhyme-Book*, and several volumes of prose writings, including *Seek and Find*, *Letter and Spirit* and *Time Flies*. She is generally ranked, with ELIZABETH BARRETT BROWNING, as one of the two greatest women poets of the VICTORIAN ERA. See also ENGLISH LITERATURE.

BIBLIOGRAPHY.—E. L. Cary, *The Rossettis: Dante Gabriel and Christina*, 1900, M. P. Sanders, *Life of Christina Rossetti*, 1930; F. Shove, *Christina Rossetti*, 1931.

ROSSETTI, DANTE GABRIEL (1828-82), English poet and artist, was born in London, May 12, 1828, the son of an exiled Italian poet and professor. He left school at 15 to study painting in various London academies. In 1848 he united with HOLMAN HUNT, J. E. MILLAIS and several other young artists to form the Pre-Raphaelite Brotherhood (see PRE-RAPHAELITISM). He was a conspicuous member of the Brotherhood, by reason both of his paintings and of the poems and writings he contributed to the Pre-Raphaelite organs, *The Germ* and *The Oxford and Cambridge Magazine*. He was later associated with Burne-Jones, John Ruskin, William Morris, Swinburne

and other prominent members of the Pre-Raphaelite group. As a painter Rossetti was imaginative and highly poetic in his choice of subject, preferring scenes from mythology or from medieval sources. He was a good designer and a superb colorist. He is especially noted for his paintings of women, large-eyed, pallid, ethereal creatures, modeled principally after his sister, CHRISTINA ROSSETTI, or after Mrs. William Morris. Many of his works now hang in London galleries, and among the better known are the triptych of *Paolo and Francesca*, *Proserpina in Hades*, *Beata Beatrix*, *Venus Verticordia*, *Pandora*, *Monna Vanna*, *The Blessed Damozel* and *Dante's Dream*.

Rossetti was perhaps greater as a poet than as a painter. His first publication was *Early Italian Poets*, which appeared in 1861 and was re-issued in 1874 as *Dante and his Circle*; this work, containing Dante's *Vita Nuova* and poems by several of Dante's contemporaries, ranks as one of the greatest translations ever made into English. Rossetti's own poetic works comprise only two volumes, yet establish him as an outstanding poet of the 19th century. His first volume, *Poems*, appeared in 1870; the second, *Ballads and Sonnets*, in 1881. He was a master of the sonnet form, and is probably best known for his sonnet sequence, *The House of Life*. As in painting, so also in poetry he preferred the beauty of the past to the strident realities of his own day. He was a subtle and meticulous craftsman. His better known poems include *Dante at Verona*, *Sister Helen*, *The King's Tragedy*, *A Last Confession*, *Eden Bower*, *Burden of Nineveh* and *The Blessed Damozel*. The last decade of Rossetti's life was spent as a virtual recluse, chiefly at his home in CHEYNE WALK, London. Adverse criticism had embittered him, and the death of his wife, ill health and the narcotic habit added to his wretchedness. He died at Birchington, Apr. 9, 1882, and was buried there. See also ENGLISH LITERATURE.

BIBLIOGRAPHY.—E. L. Cary, *The Rossettis: Dante Gabriel and Christina*, 1900, A. C. Benson, *Rossetti*, 1904; Evelyn Waugh, *Rossetti, His Life and Works*, 1928.

ROSSINI, GIOACCHINO ANTONIO (1792-1868), Italian music composer, was born at Pesaro, Feb. 29, 1792. His chief instruction was received at Bologna Conservatory. By the time he was 20 he had received several commissions to compose comic-operas, and between 1815 and 1823 he wrote an average of two such works yearly. His first considerable success was *Tancredi*, produced in 1813, followed by *The Barber of Seville*, produced three years later under the title *Almaviva*. Several less pronounced successes followed before the production in 1823 of *Semiramide* and in 1829 of *William Tell*. In the latter year, partly because of pique over the sudden rise to favor of MEYERBEER, and partly because of the repudiation by the French government of an agreement between Rossini and Charles X, the composer abruptly abandoned his operatic career, and spent the remainder of his life in retirement. In addition to 35 operas he composed a *Stabat Mater*, notable for the opening number *Pro peccatis*, and the *Petite Messe Solennelle*. Besides

The Barber of Seville and *William Tell*, which are securely entrenched in the opera repertory of all countries, revivals are occasionally given of *L'Italiano in Algeri*, *La Cenerentola*, and *Mosè*. Inevitably Rossini's work suffered from the rapidity with which he composed, but the student of opera cannot overlook his fertile genius, nor be unmindful of the high rank of his melodious and vivacious operas in the *bel canto* school. His influence was pronounced, even upon such individualistic successors as Verdi. Rossini died at Paris, Nov. 13, 1868.

ROSS LAND, the Antarctic discoveries made by Admiral Sir James Clark Ross in 1841-42. The Ross Archipelago consists of Ross Island, Black Island, the Dellbridge and other islets, all of which are volcanic. Ross Island is by far the largest of the group, being roughly triangular in plan and 50 mi. along each side. It is made up of the volcanoes Erebus, Terror, Bird and Terra Nova, with smaller cones. Mt. Erebus stands at the gate of the Ross Barrier, a great sheet of ice about 400 mi. wide along its seaward edge and over 400 mi. from north to south in its widest extent. By an order in council dated July 30, 1923, Great Britain created the Ross Dependency and proclaimed the coasts of Ross Sea, with the adjacent islands and territories, between 160° E. long. and 150° W. long., and south of the 60th degree of latitude, a British settlement, placed under the jurisdiction of New Zealand.

ROSTAND, EDMOND (1869-1918), French playwright and poet, was born at Marseilles, Apr. 1, 1869. Rostand early showed evidences that he could employ his poetic endowment in the theater, although his first play, *Le Gant Rouge*, was unsuccessful. In 1895 his second play, *La Princesse Loiraine*, earned him a distinct place among Continental dramatists, and two years later he composed and had produced the memorable *CYRANO DE BERGERAC*, since widely played on both sides of the Atlantic. In 1900 Rostand completed *L'Aiglon*, whose central character is the young duke de Reichstadt, son of Napoleon by Marie Louise; the rôle subsequently became famous among the characterizations of SARAH BERNHARDT. The following year Rostand's eminence in the French theater was formally recognized by his election to the French Academy. *Le Chantier*, a fantasy in which all the *dramatis personae* are fowls, was first produced at Paris in 1910, the leading part being played by Lucien Guitry. Rostand died at Paris, Dec. 2, 1918.

ROSTOCK, largest and most important city in the German State of Mecklenburg-Schwerin, on the navigable River Warnow, 8 mi. from the Baltic. Trains to Copenhagen are carried on ferry-boats from the nearby harbor Warnemunde, belonging to Rostock, to Gedser or Gjedser, the Danish port. Buildings worthy of note are the numerous 13th, 14th and 15th century churches, the Abbey church, those of Our Lady, St. Nicholas, St. Peter and St. James. There are also the fine medieval Rathaus and former mint, old city gates, the modern buildings of the university, founded about 1420, and Holy Cross Abbey, founded

in 1270. Shipbuilding and the manufacture of machines, chemicals, sugar, leather goods and furniture are extensively carried on in Rostock, which has a large trade in coal, lumber, grain, wine and petroleum. Rostock was a Slavic town in the 10th century, a German city since 1218, from 1229 to 1314 the residence of reigning princes and a Hanseatic city until 1630. Pop. 1925, 77,669.

ROSTOV-ON-DON, the administrative center and a port of the North Caucasian Region of the R.S.F.S.R., on the Don River about 30 mi. from the Sea of Azov. It is an active trading and shipping point. Since Rostov is seldom entered by any but Russian ships, merchandise is transferred at this point to or from trains and boats from TAGANROG. The exports include grains, wool and caviar. The heaviest trading is in grain and tobacco. The city has paper, tobacco, leather, metal utensil and white lead factories. It is the seat of the Don Museum of Art and Antiquity and the State University. The Commercial Row is a model of 19th century town architecture. The population is predominantly Russian. Dmitri Rostovsky founded the city bearing his name in the latter part of the 18th century as a fort. The present port dates from 1834, and trade was active almost at once. With Rostov's industrial development the city became the southern center of the labor movement, and strikes and insurrections were common in the pre-war period. The revolution of 1917 led to struggles between White and Red armies, which were terminated in 1920. Pop. 1930, 379,973.

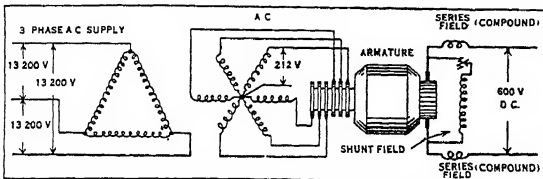
ROSTOVITZ, MICHAEL IVANOVITCH (1870-), classical archaeologist and historian, was born at Kiev, Russia, Oct. 28, 1870. After studying at the universities of Kiev and St. Petersburg, he spent several years traveling through Europe and Africa. In 1902 he was appointed assistant professor of classical philology at St. Petersburg, where in 1904 he became assistant professor and in 1908 professor of Latin philology. Soon after the Bolshevik Revolution of 1917, he left Russia and went to America. He was professor of ancient history at the University of Wisconsin from 1920 to 1925, when he became Sterling professor of ancient history and classical archaeology at Yale. His works include *Geschichte des Römischen Kolonats; A History of the Ancient World* (2 vols.); *The Social and Economic History of the Roman Empire; Mystic Italy*, and *Greeks and Iranians in South Russia*.

ROSWELL, a city in southeastern New Mexico, the county seat of Chaves Co. It is situated near the Pecos River, 210 mi. northeast of El Paso, Tex., and is served by the Santa Fé Railroad and by bus lines. There is an airport. Roswell is a trade center in a cotton, grain and apple-growing region. Many sheep and cattle are raised in this section. All farming is by irrigation coming from artesian wells, the largest of which flows 9,100 gals. a minute. The local manufactures are cottonseed products. In 1929 the retail trade amounted approximately to \$9,210. Roswell is the seat of the New Mexico Military Institute and

the gateway to Lincoln National Forest, Carlsbad Caverns and the Artesia oil fields. Because of the altitude of 3,600 ft., dry air and comfortable temperatures, the city has attracted sufferers from respiratory diseases. The city was founded in 1880 and incorporated in 1903. Pop. 1920, 7,033; 1930, 11,173.

ROTARY CLUB. See ROTARY INTERNATIONAL.

ROTARY CONVERTER, or Synchronous Converter, a machine which delivers direct current when supplied with ALTERNATING CURRENT, or which delivers alternating current when supplied with direct current. It consists of a single field structure, with shunt and compound-wound poles, and a rotating



CONNECTIONS OF 6-RING, 600-VOLT ROTARY CONVERTER

ARMATURE with SLIP-RINGS at one end and a COMMUTATOR at the other, 6-phase connections at the slip-rings being usual. TRANSFORMERS are usually necessary auxiliary equipment. Efficiencies range from 92 to 95%.

ROTARY ENGINES, engines in which the power is delivered as a rotating, rather than a reciprocating motion. Due to the erroneous popular belief that a large amount of power is lost in the translation of the reciprocating motion of the piston to the circular motion of the crankshaft, many attempts have been made to produce efficient rotary engines. Rotary steam engines may be of two types: 1. A design in which a number of cylinders are placed in a radial position, the connecting rods being yoked to a stationary crankshaft and the admission of steam forcing the cylinders to rotate; and 2. A design in which the piston is of such a shape that the action of the steam upon it causes it to revolve and drive an attached shaft. For miniature powers the second is suitable, although it has a high steam-consumption rate. Few rotary steam engines are now in use.

Rotary gasoline engines were introduced by early aviation engineers in an effort to produce a maximum amount of power in a minimum space. In those engines the cylinders and pistons were of the radial type, and the pistons were connected to a fixed crankshaft about which the entire engine rotated. See AIRCRAFT ENGINES. L. H. MO.

ROTARY HOE, an agricultural tool for the blind cultivation of young crops. The spading prongs of the hoe wheels mulch the soil and destroy seedling weeds whose root systems are not as well established as the crop being cultivated.

BIBLIOGRAPHY.—A. A. Stone, *Farm Machinery*.

ROTARY INTERNATIONAL, an organization of business men's clubs in more than 50 countries, functioning without secrecy to promote ethical relations in business under the motto, "Service not self."

It was originated in 1905 by Paul P. Harris, a Chicago lawyer, who formed a local club the members of which each represented a different profession.

Within the next five years the idea had been copied in many other cities, and the several clubs were organized as the National Association of Rotary clubs. In 1922, following the formation of clubs in European cities, the name was changed to Rotary International. The official organ of the club is *The Rotarian*.

The organization of the local clubs permits of a senior and junior member from each profession represented in the community. The local government is by a board of directors, these directors meeting with those of the other clubs in the district. District affairs are regulated by a governor, who is the delegate to the annual convention of Rotary International. The international convention elects a president and board of directors, of whom at least five must represent other nations than the United States.

In 1931, Rotary International had a membership of 3,400 clubs, representing approximately 157,000 individuals.

ROTARY TILLER, an agricultural implement for tilling soil. It has a series of fluted spools revolving on a common axle. The weight of the machine tends to firm and compact the seedbed. The shape of the spools has a tendency to work and pulverize the surface soil. The combined action of the tool produces an excellent seedbed.

BIBLIOGRAPHY.—H. P. Smith, *Farm Machinery and Equipment*.

ROTATION OF CROPS, a system of farming whereby yields of land may be maintained or increased without corresponding cost of production. Its inception is due to the failure of the one crop system, the growing of hay, cotton, corn, wheat or potatoes annually on the same area. This system results in the soil sooner or later losing its friability, becoming lumpy, baking easily, demanding increased labor to fit and manage and failing to produce profitable yields.

The first step toward correcting this evil is diversification, the growing of several instead of one money crop, but unless these crops are properly selected they merely complicate the problem. Hence the development of rotation cropping, "the recurrent succession of plants covering a regular period of years and maintained in alternating fields." For instance, a grain crop, such as wheat or flax, may be raised on one field; an intertilled crop of potatoes or mangels on another; a hay crop on a third. The following year the grain replaces the intertilled crop which is moved to the hay field and the hay is grown where the wheat has been. There are shorter, even one year, rotations, but the three- and the four-year series are most popular. In order to qualify as rotations, crops must differ both in character and management. For instance, a sequence of wheat, oats, flax, barley and other sowed crops grown for their seed would not be a rotation because they make similar demands on the soil and are handled in the same way.

Seven important advantages are gained by rotation of crops. 1. Organic matter is produced and maintained in the soil. 2. This material holds water and, decaying, produces acids which act upon inorganic materials that thus become available as food for plants. 3. The physical condition of the soil is improved and maintained so that plowing and tilling are easier. 4. Because of advantages 1, 2 and 3 crop yields are increased. 5. Hence farm income is, or should be, more stable. 6. Weeds, insects and plant diseases are largely controlled. 7. Farm labor is better distributed than by the single cropping method.

When clover or some other legume such as cowpea and vetch is grown, either for hay or more especially to be plowed under as a green manure, crop rotation has still another advantage. It increases the supply of nitrogenous plant food and obviates the application of costly nitrogenous fertilizers.

M. G. K.

ROTHENBURG-ON-TAUBER, an old town in Bavaria, remarkable for its well-preserved medieval appearance. It is surrounded by the old city walls with towers and gates dating back to the 14th and 15th centuries. Among the interesting churches are St. James', St. John's, both of the 14th-15th centuries, Holy Ghost, Franciscan Church, both 14th century, and Wolfgang's Church of the 15th century. Among secular buildings are the Roder Gate, the rectory, St. George's Fountain, St. Mark's Tower, White Tower, and the Town Hall, one of the most beautiful in Germany. Medieval pageants are frequently staged, and the old town is frequented by tourists. The chief manufactures are perambulators, machines, cement, soap and beer. The trade is in grain, cattle and wine. Tourist trade, especially from America, is important. Rothenburg was first mentioned as a fortress in 804. Pop. 1925, 8,828.

ROTHERHAM, a county borough in the West Riding of Yorkshire, England, at the junction of the Don and the Rother, about 161 mi. northwest of London. A Roman fort once lay to the southeast, at Templeborough, and during Saxon and medieval times the town prospered. Though a modern industrial development of slight beauty, Rotherham yet has a splendid 15th century parish church, and an ancient bridge across the Don upon which is a chapel. The town to-day is a center for steel, brass and iron works; breweries, glass factories, rope-works and sawmills. Pop. 1921, 68,022; 1931, 69,689.

ROTHSCHILD, HOUSE OF, a celebrated European family of bankers. It won its first prominence in the transactions of Mayer Anselm Rothschild (originally Bauer) (1743-1812), born at Frankfort-on-the-Main in 1743, a descendant of Moses Bauer, whose birth, in 1550, is the earliest family record. The name Rothschild is derived from the sign of the red shield on the house at Frankfort. The founder of the great commercial house began studies at Furth for the rabbinate, but abandoned the priesthood to begin work with his father, a money changer. About 1755, Mayer Anselm left Frankfort to work for a Hanover bank, but soon thereafter returned to his native city

and established his own business, which, under his sons, dominated the field of European finance. He became agent of William IX, of Hesse Cassel, and had charge of the negotiations for the hire, by England, of Hessian troops to fight the American colonists.

In 1789, Mayer Anselm had some financial dealings with the crown prince, and, as court agent and broker, his fortune steadily grew. When William fled at the approach of Napoleon, he gave all his treasure to Rothschild, who eventually returned it with 5% interest, having invested it wisely. He died at Frankfort on Sept. 19, 1812, the father of five sons and five daughters (all of the sons were created barons in 1822 by the Austrian emperor). The sons established branches of the Rothschild bank at London, Paris, Vienna, and Naples. The eldest son, Anselm Mayer (1773-1855), was born at Frankfort, June 12, 1773, and became Bavarian court banker in 1820. He died Dec. 6, 1855. The second son, Solomon (1774-1855), born at Frankfort, Dec. 9, 1774, undertook management of the branch at Vienna, where he established profitable relations with Metternich, and where he died, July 28, 1855.

Rothschild's third son, Nathan Mayer (1777-1836), was born at Frankfort, Sept. 16, 1777. He went to England in 1800, and established the London Bank, winning a huge fortune on the fall of Napoleon, when English shares recovered. His businesslike methods (among them the payment of foreign dividends at London in British Sterling) won him widespread confidence, and before his death at London, July 28, 1836, he was handling financial transactions for the greater part of Europe. In the 12 years following the Battle of Waterloo, the Rothschild banks raised \$100,000,000 in loans to England, Austria, Prussia, France, Naples, Russia and several German courts. Nathan Mayer was the most powerful figure of the Rothschild house and brought it much of its fame. The fourth son, Karl (1788-1855), born at Frankfort, Apr. 24, 1788, established the Naples branch in 1821, which was discontinued after the fall of the Bourbon dynasty, 1861. He died Mar. 10, 1855. The fifth son, Jacob (1792-1868), born at Frankfort, May 15, 1792, organized the Rothschild bank in Paris. He . . . the loans for the first French railroads, and . . . 15, 1868.

In addition to the five branches, the house established agencies throughout the world. In most instances, the sons of the first five brothers were the successors in the five great branches. Chief among that Rothschild generation was Lionel Nathan, eldest son of Nathan Mayer (1808-79), born Nov. 22, 1808. He was the first Jew, by creed, to enter Parliament (1847-74). He died June 3, 1879. He was succeeded in the London bank by his son, Nathaniel Mayer (1840-1915), born at London, Nov. 8, 1840. He sat in Parliament during 1865-85, was created first Lord Rothschild in 1885 and was widely known for his championship of, and gifts to, the Jewish race. He aided DISRAELI in obtaining the

Suez canal, was president of the British Red Cross and raised \$7,500,000 for the care of wounded soldiers. On his death at London, Mar. 31, 1915, the family fortune was estimated at \$2,000,000,000.

Nathaniel Mayer was followed in the London bank by his brother, Leopold de Rothschild (1845-1917), born Nov. 22, 1845, president of the United Synagogue and a noted art collector. He died at Ascot, May 29, 1917. The title of the first Lord Rothschild passed to Lionel Walter (1868-), born at London, Feb. 8, 1868. He is the author of numerous volumes on zoology, and a fellow of the Royal Society.

The financial success of the House of Rothschild, which after more than 100 years is one of the largest

still others are parasitic. Individuals of certain species join themselves together to form colonies.

Although they are of extremely small size, the largest being scarcely visible to the naked eye, rotifers are highly organized, and possess definite digestive, nervous, and excretory systems, and reproductive organs. Some forms have eyes and sensory tentacles. The body varies greatly in form. It is usually divided into an oval trunk and a foot. Many species have a shell-like armor or lorica. About the mouth are numerous cilia used in feeding and swimming. In many common forms the cilia are arranged in two circular rows which move in opposite directions, so that they look like two revolving wheels under the microscope. The sexes are separate. Among most rotifers only females have been discovered. So far as known the males are smaller than the females.

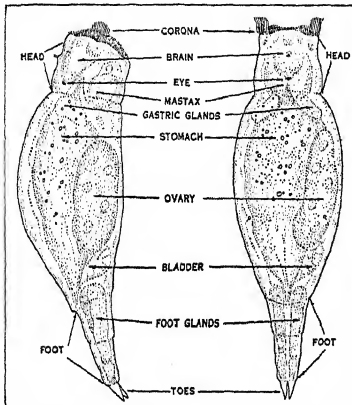
ROTTERDAM, foremost port and second chief city of Holland, situated on both banks of the main outlet of the Rhine and the broad Nieuwe Maas. The old city is intersected by a railroad viaduct, which continues on the bridges across the river. On islands south of the river, as well as in other parts of the city, are new ports and factory sections.

Among the buildings are St. Lauren's Church, 1472, a modern stock exchange, a city hall, the post office on the Coolingsel, the principal street, and the "White House" with its monuments. There are three parks and a zoological garden. Of the 20 harbors on the north and 28 on the south bank of the Nieuwe Maas, the most important is the whale harbor. Shipbuilding and repairing, together with the manufacture of machines, are foremost. Other industries supply chocolate, clothing, rugs, cotton, tobacco and printed calico. The most important shipping concerns are the Rotterdam Lloyd and the Holland-America Line. In 1927 there were 140 steamship lines represented at Rotterdam. After 1913 Rotterdam's shipping almost doubled and by 1926 it had outclassed Hamburg and Antwerp.

Rotterdam has five railroad stations with connections in all directions and is also served by air lines. Various commodity exchanges aid business, together with the numerous banks and many organizations to further commerce and trade. There are excellent schools of various sorts. There is also an institute for tropical diseases, a home for the blind, a museum for folklore and for navigation, learned societies and a fine library. In 1920, 61.6% of the population were Protestants, 24.6% Roman Catholic, 2.1% Jewish. Pop. 1930, 586,285.

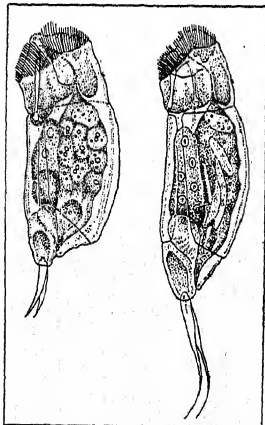
ROUBAIX, an important French textile center situated 6 mi. northeast of Lille. It is especially famous for its woollen manufactures which, with those of its suburb TOURCOING, amounted in 1914 to four-fifths of all in the north of France. The Germans occupied the town in 1914-18, but prosperity again followed the resumption of work with government assistance in 1919. Pop. 1931, 117,190.

ROUEN, an important manufacturing center and river port in Normandy, and in medieval archi-



ANATOMY OF A TYPICAL ROTIFER
Pleurotrocha petromyzon

banks in the world, is due primarily to the work of the five sons of Mayer Anselm, who coordinated their efforts and individually examined every major transaction proposed by the separate banks. Once a project was approved, the five brothers entered in promoting its success. In the face of reverses, such as the Rothschild loss of several millions in the French Revolution of 1848, they were able to avert disaster by apportioning the loss among the several branches. The direction of the enormous enterprise has been kept in the Rothschild family by the long-established practice of admitting members of every generation into the firm.



COURTESY AMER. MUS. OF NATL. HISTORY

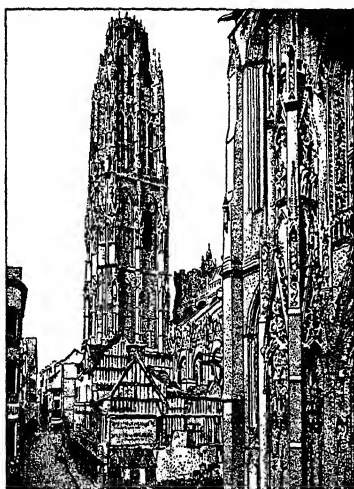
TWO SPECIES OF ROTIFERS,
SHOWING HOOKLIKE FEET
AND CILIA-COVERED HEADS

ROTIFERS, a class (*Rotifera*) of backboneless animals, called also wheel animalcules. They are com-

mon in fresh water, and are found not only in lakes and ponds, but even in temporary pools, while a few species live in the sea. Some are free swimming, others attach themselves to plants and animals, and

ture the richest city in France. It is the capital of the department of the Seine-Inférieure and an army headquarters. Rouen was the capital of Normandy, and so passed to England with William's conquest. William died here in 1087. Taken and long held by France, the town was captured by Henry V of England in 1419. In 1431 Jeanne d'Arc was tried here, and on May 30 was burned at the stake in Rouen market-place. The French recaptured the town in 1449. Among Rouen's outstanding medieval buildings are the three great churches, all Gothic masterpieces, the cathedral, St. Ouen and St. Maclou; the Palais de Justice, a notable example of Gothic civil architecture; the Hotel Bourgtheroulde; the tower of Jeanne d'Arc, and the great Belfry with its clock. Many picturesque old streets still remain. A modern monument to Jeanne d'Arc stands in the market-place. Rouen is the head of ocean-going navigation on the Seine. Its chief industry is in cotton textiles. Pop. 1931, 122,957.

The Cathedral of Notre Dame is a magnificent Gothic structure marked by great beauty of detail. Begun in the 12th century, it was finished in the 15th; but much of the work dates from the 13th century. The west portals were built, and the older of the two western towers was begun, in the 12th century. The remainder of the rich flamboyant façade is of the late 14th and early 15th centuries, and the famous Butter Tower is 15th century work; the



15TH CENTURY GOTHIC TOUR DE BEURRE
(BUTTER TOWER) OF CATHEDRAL, ROUEN

lantern over the crossing was begun in the 13th century. The sumptuous interior is finely proportioned and contains beautiful stained glass, dating from the 13th to the 16th century. Among many interesting tombs, the most celebrated is that of the cardinals of Amboise, 1518-25.

The Church of St. Ouen, a masterpiece of 14th century architecture, is noteworthy both for its harmony of style and for the richness of its decoration. It was built in great part between 1318 and 1339;

but its façade, by Viollet-le-Duc, is modern. The most famous feature of St. Ouen is the beautiful flamboyant tower above the crossing of nave and transept, which is known as the Crown of Normandy. In the south transept is a magnificent rose window.

ROUGE, FACE. See FACE PREPARATIONS.

ROUGE ET NOIR, a gambling game also called *Trente-et-un*. The players, of whom there may be any number, bet against the dealer or banker. The dealer shuffles six packs of cards together, and deals the cards, one by one, placing the reds in one pile and the blacks in another. The player may bet on red or black. The object is to win by betting on the pile that counts to nearest 31. All picture cards count 10, others their face value. The dealer deals cards of the proper color to each pile until the numbers in the pile add to 31 or over. The pile nearest 31 wins, but if exactly 31 turns up in each pile, the dealer takes half the bet.

For instance, the player bets on red. The first card dealt is the 10 of hearts, which is placed on the left, then the nine of clubs, which goes on the right. The king of diamonds would make 20 for red and the queen of spades, 19 for black. A six of hearts makes 26 for red and another queen of spades, 29 for black. A nine of diamonds makes 35 for red and a three of clubs, 32 for black. Since 32 is nearer 31, black (or the dealer) wins, and red loses his bet.

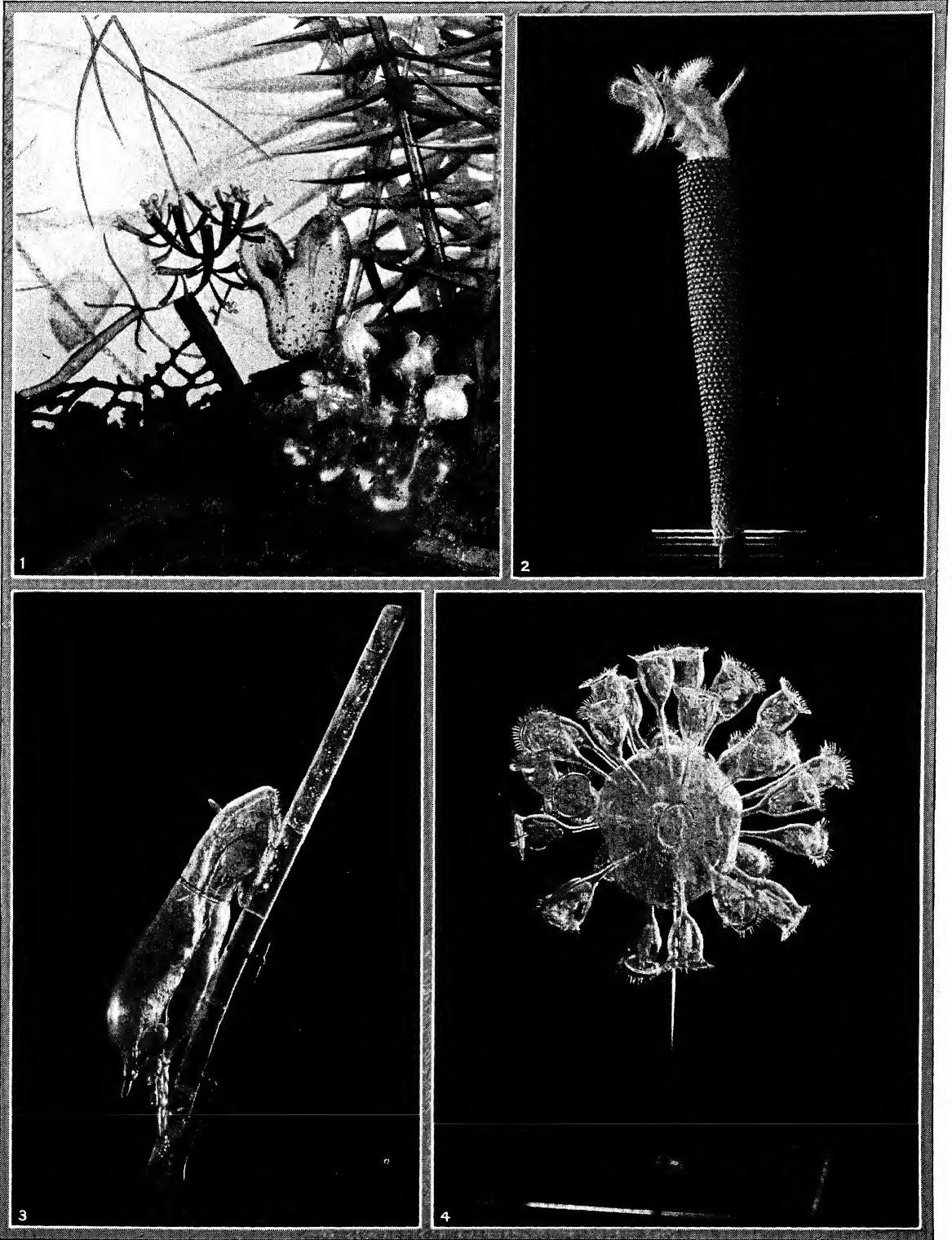
ROUGE ET LE NOIR, LE ("The Red and the Black"), a brilliant novel by STENDHAL; published 1830. Julien Sorel, poor, clever, nourishing a Napoleonic ambition for power, becomes a tutor in the house of M. de Renal, mayor of provincial Verrières. In his love affair with Mme. de Renal his belief in the effectiveness of subterfuge and cold-heartedness is tremendously reinforced. Quitting the Renals, he studies at a Jesuit seminary, and later becomes secretary to the Marquis de la Mole at Paris. Mathilde, the marquis's romantic daughter, falls madly in love with Julien, but the hero remains quite untouched by her love. In the end he is guillotined and is reverently buried by an old friend and the grief-stricken Mathilde. Three days after Julien's funeral the pathetic Mme. de Renal dies of a broken heart.

ROUGET DE LISLE, CLAUDE JOSEPH (1760-1836), French poet and composer, was born at Lons-le-Saunier, May 10, 1760, and was early commissioned captain in the army. Stationed at Strasbourg in Apr., 1792, he wrote, at high pitch of patriotic fervor, the words and music of a song which he called *Chant de Guerre de l'Armée du Rhin*, but which, sung at the storming of the Tuileries, became immortally famous as the *Marseillaise*. After 1796 Rouget de Lisle devoted himself to poetry and music. Louis Philippe made him a knight of the Legion of Honor. He died at Choisy-le-Roi, June 26, 1836.

ROUGHAGE CUTTER. See CUTTERS, AGRICULTURAL.

ROUGHAGES, for livestock, are the coarser, more bulky feeding stuffs, which are high in crude fiber.

ROTIFERS



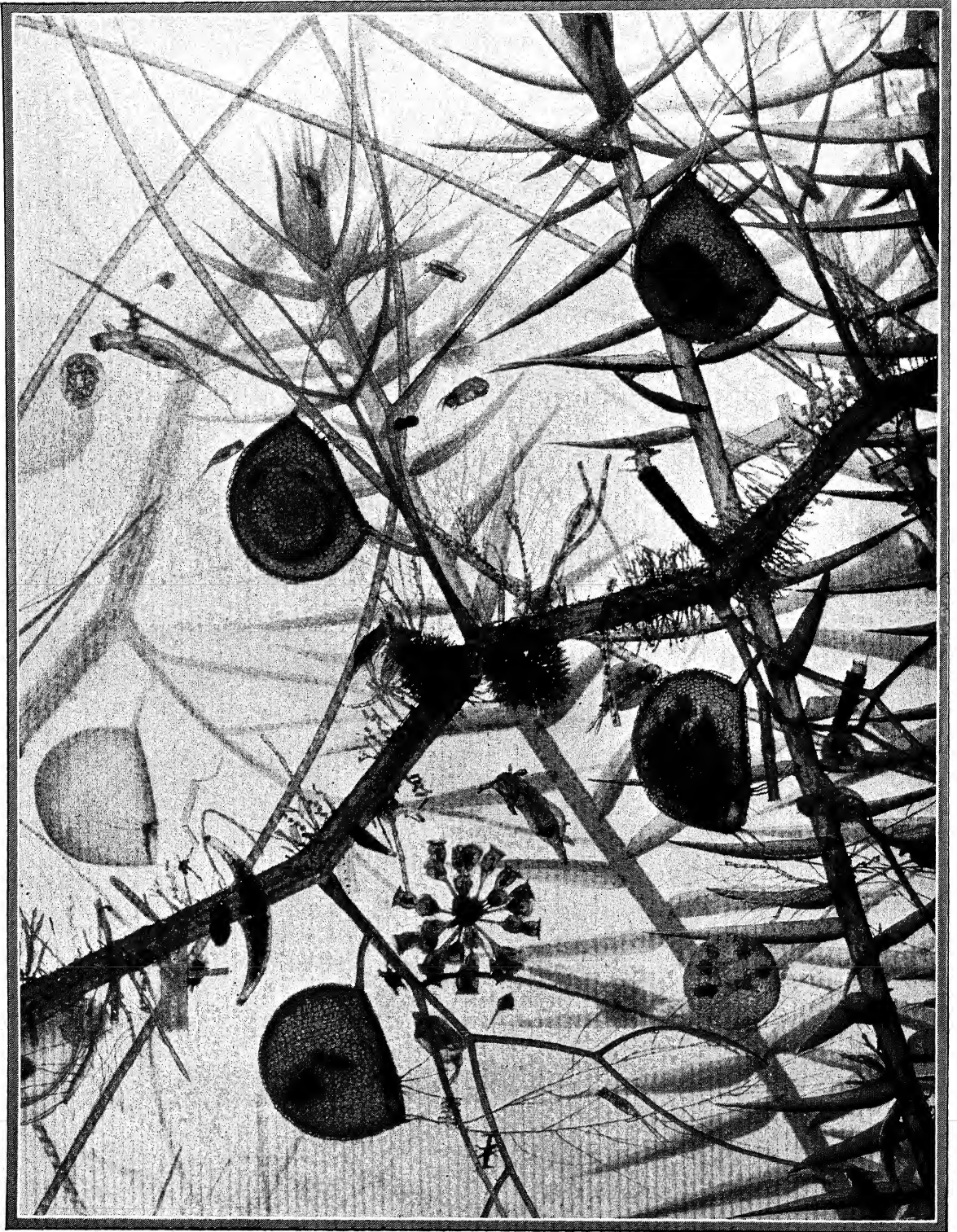
PHOTOGRAPHS OF GLASS MODELS, COURTESY AMERICAN MUSEUM OF NATURAL HISTORY

IN A DROP OF WATER UNDER A MICROSCOPE

1. Rotifers, or "wheel bearers," animalcules of many species with rapidly vibrating rows of hair or cilia on their heads which give the appearance of rotation. 2. Tube-building

rotifer which makes the spherical bricks of its body. 3. *Notommata copeus* rotifer boring plant cells to obtain chlorophyll. 4. *Conochilus valvox* colony of rotifers.

ROTIFERS



COURTESY AMERICAN MUSEUM OF NATURAL HISTORY

MICROSCOPIC ANIMAL LIFE IN A HALF INCH OF POND-BOTTOM

Section of the Rotifer Group in the American Museum of Natural History, exquisitely modeled in glass by Herman O. Mueller. A spray of the carnivorous water plant *Utricularia vulgaris* spreads its bladder-shaped animal traps to snare the microscopic rotifers and other tiny creatures which make up its food. In the lower center one such bladderwort is seen with several rotifers captured within.

They usually possess a lower percent of digestible nutrients than do CONCENTRATED FEEDS.

A large number of forage plants are utilized as roughages. These are classified as follows:

- | | |
|---------------------|----------------------------|
| I Dried Roughages | II Succulent Roughages |
| 1 Hays | 1 Silage |
| (a) legume | 2 Soiling crops |
| (b) non-legume | 3 Roots |
| (c) mixed | 4 Tubers |
| 2 Fodder and stover | 5 Miscellaneous succulents |
| 3. Straw and chaff | |
| (a) small grain | |
| (b) legume | |

Dried Roughages. These form the principal part of the roughage ration when suitable PASTURE is not available. The hays are the most nutritious of this class of roughage. The quality and feeding value of hay and fodder is influenced considerably by the time of cutting and manner in which it is cured. Hay of good quality must be cut before it becomes too mature, and cured with the retention of most of its leaves and much of its natural green color. Such hay is higher in PROTEIN, lower in crude fiber, and higher in readily assimilated minerals than hay of medium or poor quality.

Legume hays are usually higher in protein content and in calcium than non-legume hays of equal quality. Alfalfa is the legume most widely grown for hay making. It produces a large yield per acre of readily cured fine-stemmed palatable hay high in protein and calcium. When ground it is marketed as alfalfa meal. Medium red clover often seeded with timothy, is also widely grown. Soy beans and lespedeza, make palatable hays as high in protein as alfalfa. Other legumes used to some extent for hay making include the cow pea, field pea, vetches and sweet clover.

Non-leguminous hays include grass hays and grain hays made from the smaller cereals. They contain less protein and mineral matter than the legume hays, but are higher in carbohydrates and fats. They make a satisfactory feed if they are cut early and properly cured. Timothy is one of the most widely grown for grass hay. Other important hay grasses include red top, orchard grass, brome grass, Sudan grass, the sweet sorghums or sorghos, the millets, and a number of wild or native grasses. Small grains that are used as hay crops include oats, barley, wheat and rye. Grain hays are similar in composition and feeding value to grass hays. The awns or beards on some varieties of barley and wheat makes them undesirable for feeding.

Mixed hays consist of legumes and non-legumes grown together and cut for hay. Combinations utilized for this purpose include oats and vetch, wheat and vetch, oats and peas, Sudan grass and soy beans, as well as clover and timothy and alfalfa and timothy. Mixed hays are usually intermediate in protein and mineral content and in feeding value between straight legume and straight non-legume hays.

Fodders consist of the widely grown Indian corn and the grain sorghums, cured and fed to livestock with the ear or grain attached. These crops yield a large amount of dry matter per acre. Because of their grain content, they are often higher in feeding value than the other non-legumes. Stover is fodder from which the ears or grain have been removed. It is lower in feeding value than fodder and the grass hays.

Straw and chaff consist of the residue left after the grain or seeds have been threshed from the smaller cereals and leguminous plants, cut at a mature stage for seed. The principal straws available are the cereal straws from oats, barley, wheat and rye. These are all high in crude fiber and low in protein and minerals, and have the lowest value of all feeding stuffs.

Succulent Roughages. Silage provides one of the best and cheapest of succulent feeds, and is available for feeding throughout the year. It is produced by a natural fermentation brought about when green feed containing a high percent of water is placed in a silo with air tight walls or in trenches and packed in such a manner as to exclude the air. Corn is the most desirable and widely used silage plant, producing a palatable succulent feed. Both the saccharine and non-saccharine or grain sorghums also make silage of good quality. Sunflowers and some of the legumes, grasses and small grains used alone or in mixtures, are occasionally made into silage.

Soiling crops are forages cut and fed in their fresh green state. Special crops are sometimes planted to be used especially for this purpose. Alfalfa and green corn provide excellent soiling crops. Other desirable soiling crops include rye, oats, peas and wheat and vetch, Sudan grass, soy beans and cowpeas. Like pasture, these feeds are high in vitamins, and provide minerals in an easily assimilable form.

Root crops are available for livestock feeding during the fall and winter months. While bulky in nature and high in water content, the dry matter which they contain is low in crude fiber, and high in digestible nutrients. Because succulent feeds can usually be provided more cheaply in the form of silage, roots are not generally used for livestock feeding except in localities where labor and climatic conditions are favorable for the production of a large tonnage per acre at a low cost. Common root crops fed the livestock are mangel, sugar beet, half-sugar mangel, rutabaga, turnip, carrot and parsnip.

A number of miscellaneous succulent feeds sometimes used for livestock feeding include the cabbage, kohlrabi, rape pumpkins, potatoes, squashes, melons and windfall fruits of various kinds. See also CONCENTRATED FEEDS; PASTURE.

J. B. S.

ROULEAU, RAYMOND MAIRE, CARDINAL (1866-1931), Canadian divine, was born in Isle-Verte, Quebec, Apr. 6, 1866, and educated at the seminary of Rimouski. He entered the order of Dominican Fathers in 1866, and in 1892 was ordained a priest. After being prior of the House of Dominican Fathers

in Ottawa, and provincial of the Dominican province of Canada, he served as bishop of Valleyfield, Quebec, in 1923-26 and in the latter year became archbishop of Quebec. In 1927 he was made a Cardinal. He died May 31, 1931.

ROULERS (Flemish, *Roeselare*), capital of a district in the Belgian province of West Flanders located on the Mandel River. Its products are cotton, half-wool goods, linen lap-ropes and chicory. An active trade in linen is carried on. Roulers has the stately church of St. Michael and a fine city hall. Pop. 1930, 27,690.

ROULETTE, a gambling game of French invention consisting chiefly of a wheel, circumscribed by numbers corresponding to those on the roulette table. In most countries, as in the United States, roulette is specifically prohibited by statute. The game is generally played on a long table, on which is laid out a square containing the numbers zero to 36. Small divisions at both sides of the digits are marked *passe* (numbers 19-36), *pair* (even numbers), *manque* (numbers 1-18), *impair* (odd numbers), and two colors, the red and black diamonds. The roulette wheel, at the head of the table, is spun by the *croupier*, who after spinning the cylinder throws a small ball into the wheel. The ball falls into a cylinder compartment where it rests until the wheel stops before one of the numbers (bearing a color) surrounding the wheel. There are many methods of playing; but the odds in the long run are with the bank. At Monte Carlo a stake played directly on a number pays the winner 35 times the stake. The scale runs down a large number of combinations: *à cheval*, *transversale plein*, *en carré*, etc., to simple play on black or red, odd or even, which pay the winner even money. The minimum stake at Monte Carlo is 10 francs.

ROULETTE, in engraving, a little wheel set with sharp teeth on its outer circumference, for the purpose of roughening the surface of a copperplate to hold ink, in the production of a MEZZOTINT. Each application of the wheel gives one row of dark dots in the picture, and it is a slow process to build up the shadows in this way. The roulette was partially superseded by the **ROCKER** about 1675, although still used for alterations and fine detail.

ROUMANILLE, JOSEPH (1818-91), Provençal poet, was born at Saint-Remy, Aug. 8, 1818. In the revival of the langue d'oc, or Provençal, he was the moving force. He is surnamed "le père felibrige," on account of his leadership of the movement for the conservation and propagation of the ancient language of Provence. He began early to write in Provençal, especially struggling to purify the language by restoring the ancient words, and using the ancient orthography of the **TROUBADOURS**. A conference at Fontsegugne in 1854 marked the official founding of the *Félibrige* community. Roumanille's poems, *lis oubreto*, were collected after his death, which occurred at Avignon, May 24, 1891.

ROUNDELAY, a verse form originated in France, otherwise known as the **RONDEAU**; a song in which

a line is repeated as a refrain, or the tune of such a song; also, a dance in a circle. In its Anglo-Saxon meaning the roundelay refers to a poem of any length in which the same line occurs between stanzas as a refrain. In this sense, the well-known early English poem, *Summer is icumen in*, dating from about 1250, with its refrain "Lhude sing cuccu," is a roundelay. The roundelay is the form of many folksongs, especially of those to which people danced in circles.

ROUNDHEADS, supporters of the parliamentary cause during the English civil war of the 17th century. The name was first used derisively in 1641, and arose from the fact that Puritans often wore their hair cropped closely, while gentlemen (Cavaliers) affected long ringlets.

ROUND HOUSE. See **RAILROAD BUILDINGS**.

ROUND TABLE, in the **ARTHURIAN LEGENDS**, the circular table supposed to have been made by Merlin the Magician, which was given by King Leodegraunce to King Arthur when the latter married Guinevere. Arthur's knights were known as the **KNIGHTS OF THE ROUND TABLE**.

ROUND WORM, the common name for members of a genus (*Ascaris*) of threadworms (*Nematoda*), which, as adults, are intestinal parasites of birds and mammals. One species (*Ascaris lumbricoides*) is a common parasite of man and domestic animals.

The infective larvæ, on being introduced into the body of the host, enter the circulatory system and travel with the blood stream through the lungs. They then make their way to the mouth through the windpipe, and finally pass down the digestive tract, and establish themselves in the intestine, where they grow to maturity. In their passage through the lungs the larvæ may cause serious trouble, and even produce a form of pneumonia in the host. They often kill young pigs. The term round worm is sometimes used for any **THREADWORM**.

ROUND WORMS: Diseases caused by. See **PARASITIC DISEASES**.

ROUSSEAU, JEAN JACQUES (1712-78), French philosopher and social reformer, was born at Geneva, June 28, 1712. His early life was largely that of a vagabond. Little is known of it excepting what is gained from his *Confessions*. Although not particularly reliable, these accounts, nevertheless, make it safe to say that Rousseau was something of a reprobate. In 1741 he went to Paris, where his fortune was a varied one. At times he would pursue his trade of copying music and met with varied success as a composer. It was his prize essay, 1749, that finally brought him to the front. In this year the Dijon Academy offered a prize for the best essay on the effect of the arts and sciences on civilization. Rousseau's treatment, in which he showed that science and art have a harmful influence on civilization and that the natural state of man is preferable to the artificial one of civilization, became the foundation for his later work. His praise of primitive life was best expressed in his essay of 1755, the *Origin of Inequality*. From 1749 until the publication of

his *Emile*, in 1765, was the period of his most significant literary activity. For more than a decade prior to his death Rousseau was mentally unbalanced. Although there is no doubt but that he was persecuted, he nevertheless suffered delusions of persecution. Finally in 1765 Hume took pity on him and invited him to England, but he could stand London only for a short time and eventually quarreled with his benefactors. This was but a repetition of his life's story. Rousseau returned to Paris in 1770 and again resorted to copying music. He died at Ermenonville, an estate near Paris, July 2, 1778.

In three fields Rousseau is a notable figure. His *Social Contract*, 1762, places him among the leading exponents of the compact theory of society. In it he sets out to answer the question as to why men are by nature free and equal and yet everywhere about him they are in chains. With a good bit of metaphysical subtlety he develops the distinction between the will of all and what he calls the general will. *The New Heloise*, 1760, did for literature what the *Emile* was to do for education and what the *Social Contract* had done for society. It is a novel containing a love story of a woman of noble birth who falls in love with a man of lower rank, but who for the sake of convention marries within her sphere. Probably no single work has exerted a greater influence on education than has Rousseau's *Emile*. In this story an education according to nature is expounded. Nature is used in rather an ambiguous sense, and at times it is difficult to know exactly what the author means by it. At least three meanings stand out. In the first place nature may be identified with the original, the primitive, the instinctive impulses of man. In the second place it may stand for development, the realization of natural capacities. And finally it may mean living next to nature, associating with it and enjoying its beauties to the fullest extent. In whatever sense the term be accepted Rousseau sounded a wholesome note in education. Many of its modern developments may be traced to his influence. Among these may be cited the emphasis upon the child and his interests, the guidance and development of interests as over against the stimulation of artificial effort, and widening of the curriculum to include a closer contact with the objects of nature.

ROUSSEAU, PIERRE ÉTIENNE THÉODORE (1812-67), French landscape painter, was born in Paris, Apr. 15, 1812. Like all contemporary romantic painters he suffered at the hands of the Salon authorities. In 1836 his fine canvas *La Descente des vaches* was rejected by the classic painters and it was not till 1848 that Rousseau received adequate representation. In that year the painter became a permanent resident of Barbizon, where he lived until his death. (See also BARBIZON SCHOOL) His masterpiece, *Edge of the Forest of Fontainebleau*, now in the Louvre, Paris, was commissioned by the State and exhibited at the Salon of 1855. Rousseau was a great painter of trees; his woodland scenes are rich in detail; so constantly

did he work and rework his canvases that he left few finished pieces. Rousseau's last years were darkened by the insanity of his wife. The painter died at Barbizon, Dec. 22, 1867.

ROUX, PIERRE PAUL EMILE (1853-), French bacteriologist, was born at Confolens, Charente, Dec. 17, 1853. He studied medicine and obtained an appointment to the Faculty of Medicine in Paris. He worked for ten years in Pasteur's laboratory, and was director of the Pasteur Institute from 1904 to 1918. Roux collaborated with Pasteur in many researches on treatment of infectious diseases, particularly hydrophobia. He studied anthrax with Pasteur and Chamberland, and was successful in producing vaccines against this disease. In association with Yersin, he studied diphtheria bacillus and its toxins. He and von Behring introduced the use of antitoxin in diphtheria and they shared in the Nobel prize in 1901 for their work on this disease. M. F.

ROVIGO, a city of Italy, capital of the province of the same name in Venetia, northeastern Italy, situated on the Bologna-Venice Railroad. It is the seat of a bishop and contains ruins of a citadel, Church of the Madonna del Socorio, 1591, advanced schools, a scientific academy, library and a picture-gallery, chiefly of the Venetian school. There is cultivation of grain, asparagus and peaches. Pop. 1931, 37,355.

ROVING, a textile manufacturing process by which a strand of fibers is reduced by drafting (drawing out) to a size suitable to be spun. Usually a certain amount of "doubling" or combining of strands is conducted at the same time for the sake of presenting a uniform diameter and weight to the spinning frame. In some cases, notably worsted (see WOOL AND WOOL MANUFACTURE), roving is considered to be a part of the drawing. In others, notably cotton (see COTTON MANUFACTURE), it is considered as a separate and subsequent process.

ROWELL, NEWTON WESLEY (1867-), Canadian statesman, was born in Middlesex Co., Ontario, Nov. 1, 1867. He was educated in the Ontario Law Society and became leader of the Liberal opposition in the Ontario legislature in 1911-17. He was a Liberal Unionist member of the Dominion parliament and president of the Privy Council in 1917-20; and a member of the Imperial War Cabinet in 1918. In 1920 he resumed law practice at Toronto. He published *The British Empire and World Peace, Canada, a Nation*.

ROWING, as a form of competitive sport, may be said to have originated with professionals rather than with amateurs, which has not often been the case with sports in general. The earliest racing of which we have any records are those between professional oarsmen on the Thames River of England, rowing either on bets or for purses put up as prizes by the supporters of one man or another. Probably the first real oarsmen were the Thames River watermen. For many years the Thames had been a main vein of travel, with these professional boatmen as the

handlers of that traffic. In 1514 Henry VIII passed a statute for the regulation of watermen and their fares.

Pepys Diary for 1661 speaks of a "wager race" on the Thames between these boatmen, and it is certain that these occurrences were quite frequent at that time. The oldest organized race that still exists is the race for Thomas Doggett's Coat and Badge, which was instituted in 1716 and has been rowed annually except during the World War. Following suspension for this, the race was rowed five times in one year in order to maintain the unbroken string. This race was for men coming out of their apprenticeship as watermen, and the badge and coat were uniforms granted to licensed watermen. Thomas Doggett was a famous actor-manager of his day, and the race is one of about five miles on the London Thames.

Popularity in America. In America, rowing as a competition started in very similar fashion, and, apparently, in the waters surrounding New York. In the last half of the 18th century, boatmen plied between what is now the island of Manhattan and Brooklyn, Staten Island and New Jersey. They lay off the foot of Manhattan in the upper bay and held frequent races for wagers among themselves. The earliest recorded race occurred in 1756. There are evidences of sporadic racing for the next 50 years or so, all of it among professionals and for wagers. In the early part of the 19th century, southern plantation owners purchased boats, and these, manned by slaves, were considered among the fastest of their day. The first international race came in 1824 between the gig of a British frigate, *Hussar*, which visited New York, and a crew of ferrymen. The New Yorkers won.

Rowing as a sport spread over the country, and before the Civil War there was college racing and amateur club rowing practically throughout the country wherever a body of water suitable for rowing could be found. The oldest boat club in the country is the Detroit Boat Club, founded in 1839. Philadelphia's boat clubs along the Schuylkill have been in existence since 1858. There was formal club rowing in Michigan, Wisconsin, Georgia and even some in California. In New York City the days before the Civil War saw club rowing the favored avocation of sportingly inclined society, with clubs lining the Hudson at the point where most transatlantic liners of to-day dock.

After the Civil War, club rowing fell off and the next age was the age of the professional single sculler. These men, until almost the start of the present century, attracted as much attention with their races as the modern heavyweight prize fighters. Their match races caused worldwide attention, with telegraphic bulletins flashing around the world and huge crowds attending their races. Edward Hanlan, of Canada, was generally agreed to be the best of these men, with Charles E. Courtney of Cornell University coaching fame perhaps the next best, though James Ten Eyck, Jake Gaudaur, Wallace Ross, Fred Plaisted, Ellis

Ward and his three brothers were other very able scullers and racers.

Rowing has not, of course, been confined to England and America, though these countries have turned out more good crews than any others. Olympic regattas of the past have seen Russian, Finnish, Swedish, Italian, French, Belgian, German, Austrian, Danish, Australian and Italian oarsmen and crews entered. To-day Germany has college and club rowing and regattas; Italy has local regattas and sends crews to foreign competition; France is not rowing quite so much as in the past, but Belgium continues. Perhaps the most famous of these crews has been the Belgian eights of 1906, 1907 and 1909, who won the Grand Challenge Cup at the British Henley.

College Races of Major Interest. The latest rowing age seems to be the age of the colleges. Club rowing still exists successfully in a number of cities; but modern motors, ashore and afloat, have slackened it. College rowing has become a major sport in several colleges. The oldest annual college sporting events of the United States and England are the University Boat Race between Oxford and Cambridge, started in 1829, and the Yale-Harvard Race, started in 1852.

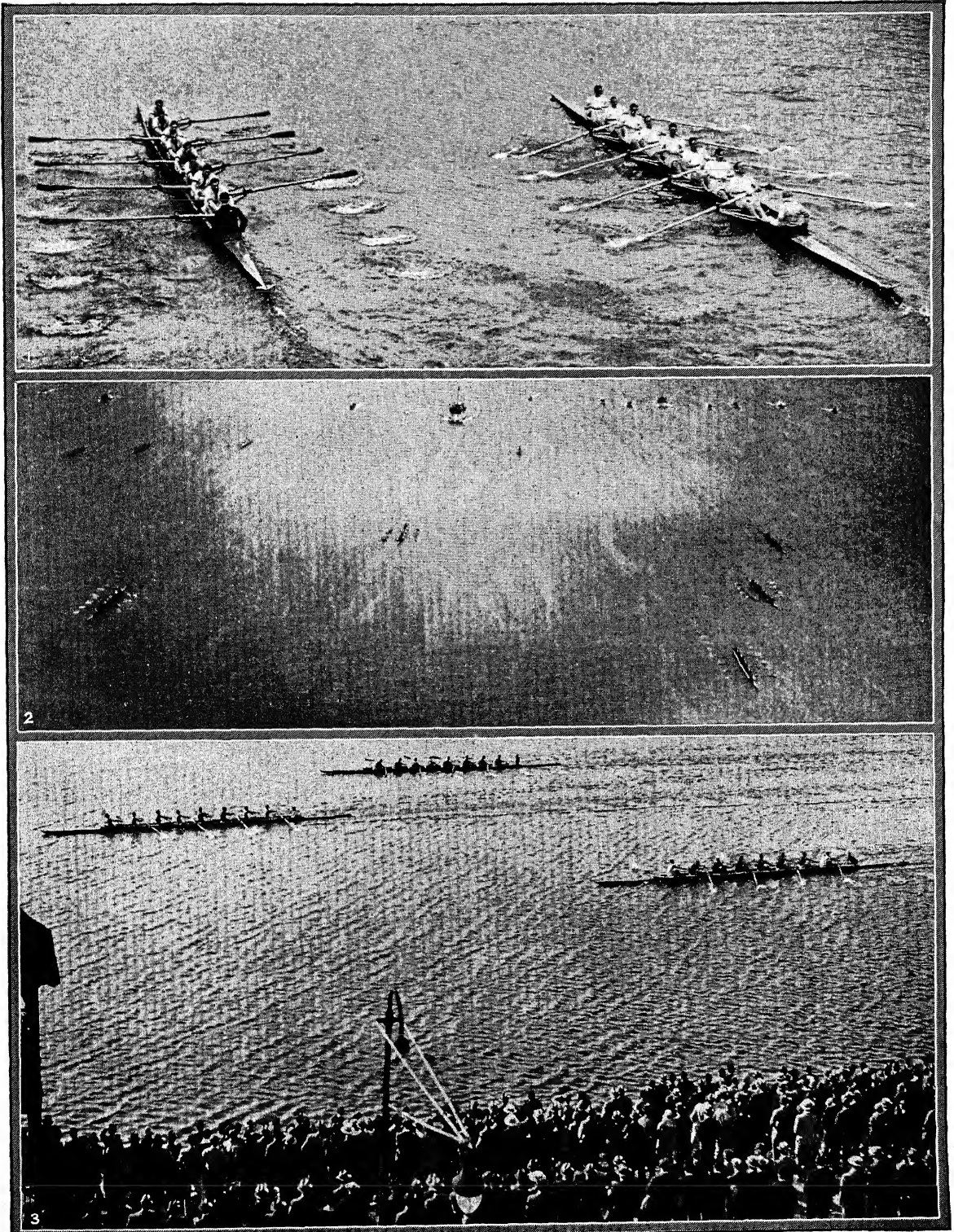
College rowing, however, confines itself almost entirely to eight-oared shell racing, leaving the racing for singles, doubles and Quads to the club crews. Its two climaxes are the four-mile races of the Intercollegiate Rowing Association at Poughkeepsie, N.Y., over the Hudson River, and between Yale and Harvard at New London, Conn., over the Thames River. These races come late in June and are preceded by a series of races and regattas over shorter distances during the earlier season. The Intercollegiate Rowing Association Regatta has been held, with one exception, at Poughkeepsie since 1895, save for the years of America's participation in the World War. Yale and Harvard have been rowing at New London since 1876. Prior to this date, college regattas were held in which Yale and Harvard joined, and at various places, among them Saratoga Lake, Springfield and Worcester, Mass.

The national championships of the National Association of Amateur Oarsmen are held for club crews each year on dates and at places assigned each year.

Rowing was introduced to the Olympic Games in 1908, and were won for two Olympiads by British crews. In 1920 the United States Naval Academy crew won; in 1924 Yale University, and in 1928, California University. Prior to the Olympic rowing, the British Henley, started in 1839, was the major rowing event of the world and drew frequent foreign entries. The major prize, the Grand Challenge Cup for eights, has been won only once by an American crew, Harvard University winning in 1914. The Diamond Sculls, highest award for single scullers, has been won only twice by Americans, by Edward H. Ten Eyck in 1897, and by Walter Hoover in 1923.

Most racing is done in shells. An eight of to-day is made of cedar and averages about 60 feet in length, and 24 inches, or a bit more, in width at its widest

ROWING



1, PHOTO BY CENTRAL NEWS FROM UNDERWOOD & UNDERWOOD; 2, 3, WIDE WORLD PHOTOS

UNIVERSITY CREWS IN AMERICA AND ENGLAND

1. A view of the annual race between Oxford and Cambridge on the Thames.
2. The annual Poughkeepsie regatta on the Hudson River in which the crews of leading universities take part.
3. At left, the Columbia crew winning the Childs Cup in a regatta on the Schuylkill River, Philadelphia.

part. Sliding seats which go on rollers are used, and metal outriggers which permit oars between 12 and 12½ feet are attached. These principal styles of shells have remained unchanged since the middle of the past century, so far as basic design is concerned. R. F. K.

ROWING MACHINES, mechanical contrivances, designed to furnish indoor gymnastic exercise equivalent to rowing. These devices generally consist of one or two handles, corresponding to oars, which are restrained by adjustable springs or weights. A slide, or sliding-seat, running backward and forward on rollers or in slotted grooves with the swing of the body, heightens the realism, and permits the crew member during indoor training to approximate actual rowing conditions. A stretch, or brace for the feet, is also provided. In training college crews, rowing machines are often installed eight in a row, so that the crew may train in unison, as it would in a shell on the water. Variations of the crew rowing machine are sold widely in the United States. These "home gymnasiums" are designed to provide a variety of exercises for the arms, shoulders, legs, and abdominal and back muscles.

ROWLAND, HENRY AUGUSTUS (1848-1901), American physicist, was born at Honesdale, Pa., Nov. 27, 1848. He was appointed first professor of physics at Johns Hopkins in 1875. His contributions in physics covered a wide field and included such fundamental experiments as the determination of the mechanical equivalent of heat, and the proof that an electric charge in motion possesses all the properties of an electric current. His greatest fame rests upon his construction of gratings or rulings made on glass or metal, containing up to 20,000 lines per inch, which inaugurated modern precision spectroscopy, and upon his pioneer work in photographing the solar spectrum. He died at Baltimore, Md., Apr. 16, 1901.

ROYAL ARCANUM, a fraternal society in the United States, incorporated at Boston, Mass., in 1877. The organization was formed chiefly for financial benefits to members, who are assessed sums for life insurance and for pecuniary aid in old age or time of illness. Membership is restricted to men. A supreme council with headquarters at Boston governs the state councils, which in turn control the local or subordinate bodies. The necessity of increasing assessments caused a considerable decline in membership, which in 1915 numbered approximately 245,000. In 1930 the membership of the Royal Arcanum was approximately 95,000.

ROYAL FERN (*Osmunda regalis*), a large handsome fern of the royal fern family called also king's-fern and royal Osmond. It grows in low woodlands and swamps in most regions of the world and is common in eastern North America. The stout rootstock bears a cluster of long-stalked bipinnate leaves, 2 to 6 ft. high, with the fertile spore-bearing portions forming a contracted terminal panicle. The royal fern, universally admired for its elegant foliage, may be successfully transplanted to shady moist grounds.

ROYAL GORGE, a section of the Grand Canyon of the Arkansas River, in Fremont Co., Colorado, 6 mi. west of Canyon City and 47 mi. west of Pueblo. The gorge, one of the scenic wonders of the west, has been cut by the river to a depth of 1,100 ft. Its walls rise sheer from the water and in some instances actually overhang. Lt. Zebulon M. Pike made the first recorded exploration in 1806 and in 1878 the Denver and Rio Grande Western railroad completed its roadbed through the gorge at great expenditure of money and danger to workmen. At one place where the canyon is only 50 ft. wide the tracks are laid on a hanging bridge suspended from the walls of the canyon. An automobile bridge with an 880 ft. span and 1,053 ft. above the tracks of the railroad was completed Dec. 8, 1929. This bridge, the highest up to then constructed in the world is reached by motor road from Canyon City.

ROYAL OAK, a city of Oakland Co., southeastern Michigan, situated on Woodward Avenue, midway between Detroit and Pontiac, which are about 25 mi. apart. A residential suburb of these cities, it is served by the Grand Trunk Railroad and by interurban and nation-wide bus lines. Royal Oak is a shopping center. The retail trade in 1929 amounted to \$13,734,432. Detroit Zoological Park, a show-place of its type, is within the city's limits. Royal Oak was incorporated as a village in 1891 and as a city, with commission-manager form of government, in 1921. Pop. 1920, 6,007; 1930, 22,904.

ROYAL PALM PARK, a state park near Homestead, Florida, and 48 mi. southwest of Miami. The park was created in 1915 and enlarged to an area of 4,000 acres in 1921. It contains a rich tropical jungle with royal palms reaching 100 ft. in height, large liveoaks, and a great variety of plants, birds, and insects.

ROYAL SOCIETY OF LONDON, a British scientific society which functions to encourage discovery and invention and to promote industrial progress. The society was conceived in 1645, organized in 1660 and incorporated in 1662. Its organ is the *Philosophical Transactions*, first issued in 1664. The members hold weekly meetings from November to June to discuss scientific subjects.

The society acts in an advisory, or semi-official, capacity with respect to the government, and it receives an appropriation of about \$30,000 from Parliament each year to be used in the furtherance of its work. Included in its wide range of activities are participation in the direction of the Royal Observatory, the sponsoring of important scientific expeditions and the study of diseases. Each year it awards five medals: the Copley, Davy, Hughes and two Royal. It also awards the Rumford and Darwin medals biennially, the Sylvester triennially and the Buchanan quinquennially.

Scientists are elected to membership in the Royal Society only upon the recommendation of six or more members, 15 candidates being voted upon annually. The number of foreign members may not exceed 50.

ROYALTIES, compensation paid to the owners of COPYRIGHTS or PATENTS for the use of the rights granted by them, the compensation usually being based upon the volume of sales; also, compensation paid for the use of a machine, usually so much per unit of production.

ROYCE, JOSIAH (1855-1916), American philosopher, was born at Grass Valley, Cal., Nov. 20, 1855. After graduating from the University of California in 1875, he studied at Leipzig and Gottingen and received his Ph.D. from Johns Hopkins in 1878. Going to Harvard in 1882 as an instructor, he became a professor there 10 years later and taught philosophy until his death at Cambridge, Mass., Sept. 14, 1916.

In 1900-01 Royce gave his Gifford Lectures on *The World and the Individual*. Much interested in symbolic logic, he contributed an essay, "The Principles of Logic," to *The Encyclopedia of the Philosophical Sciences*, 1912. Other important works are *The Spirit of Modern Philosophy*, 1892, and *The Philosophy of Loyalty*, 1908.

Royce is regarded as the best representative of American idealism. His Absolute is primarily purposive, and he refuses to allow the individual to be swallowed up in it. His ethics centers around the conception of loyalty and is best expressed by the phrase, "loyalty to loyalty." By acting with reference to this principle separate loyalties might be reconciled with each other and make possible the hope of The Great Community.

ROZANOV, VASILII VASILYEVICH (1856-1919), Russian philosophical writer and literary figure, was born Apr. 20, 1856 in Vetluga. He graduated from the University of Moscow in 1881, but had little use for a university education. His first book, *On Understanding*, 1886, was primarily a protest against the type to which he had been subjected. Although somewhat of a mystic, he was opposed to conventional Christianity. He made a religion of sex which is best expressed in his two most famous works, *Solitario*, 1912, and *Fallen Leaves*, 1913-15, the former being suppressed because of its attitude towards the Church and the latter regarded as pornographic. Among his other works are *The Place of Christianity in History*, 1890; *The Russian Church*, 1909, and *The Family Problem in Russia*, 1903. Rozanov died Jan. 23, 1919.

R. S. F. S. R. (Russian Socialist Federated Soviet Republic), a federation composed of 15 autonomous areas, 11 autonomous republics and 14 regions in Europe and Asia. The R.S.F.S.R. constitutes 93% of the total area of the U.S.S.R. of which it is a part. The territory extends from the Baltic Sea to the Pacific Ocean, and from the Arctic Ocean to the Caspian Sea; the southwestern section of European Russia bordering on the Black Sea is not a part of the R.S.F.S.R. See RUSSIA.

RUBAIYAT, the name given to a collection of Persian quatrains. The *rubāʿī*, quatrain is the oldest Persian meter and was employed by nearly all the great Persian poets. *The Rubaiyat of Omar Khayyam*, probably the most familiar of all Persian poems to

English readers, was composed by the poet and astronomer Omar, in the 11th century. First translated into verse by Edward Fitzgerald in 1859, the *Rubaiyat* is the expression of a completely disillusioned attitude towards life.

RUBBER, an elastic gum obtained from the milky fluid, or latex, of a number of varieties of tropical trees and shrubs. Rubber is also known as *caoutchouc*, probably derived from the native South American names for rubber and the rubber tree.

Formerly the world's supply of rubber was obtained from trees and vines growing naturally in the forests of South America and Africa; now most of the rubber comes from large plantations in Malaya, Sumatra and Ceylon. Most of the world's supply of rubber comes from the tree known as *Hevea brasiliensis*.

Latex is obtained from the trees by tapping. The liquid thus obtained is a water solution and suspension containing 30-35% solid material, of which about 89% is pure rubber, and the remainder proteins, fatty acids or compounds thereof (frequently called "resins"), other organic bodies and mineral salts. The colloidal properties of latex are in the main derived from the proteins and other hydrophilic colloids, chiefly soaps, which keep the rubber particles in suspension. Coagulation may be brought about by acids, salts, particularly those of the heavy metals, or by substances which tend to dehydrate and precipitate the proteins, such as alcohol.

Commercially, the term *rubber* (also crude rubber or raw rubber) is used to define the product obtained from the latex, including such other ingredients as may be present. This product is obtained by coagulation, chiefly by the admixture of acetic acid, and by spray drying.

Chemically, the term rubber refers to the elastic gum contained in the latex. This is a hydrocarbon having the empirical formula C_5H_8 . It is known to be highly polymerized. It is normally in the colloidal stage, although it has recently been discovered that it can be converted to a crystalline state. It swells and disperses in a large number of organic liquids, particularly those containing low percentages of oxygen. It is softened by heat, and at high temperatures, particularly in the presence of oxygen, it decomposes. At low temperatures it hardens. Rubber is an unsaturated hydrocarbon, containing one double bond for each C_5H_8 unit. On account of this unsaturation rubber combines with a number of elements or radicals. Halides and ozonides have been prepared. The reactions of rubber with sulphur are used in vulcanization.

W. A. G.

RUBBER ACCELERATORS. See VULCANIZATION.

RUBBER INDUSTRY, UNITED STATES. This industry comprises important manufacturing enterprises producing three main groups of articles, namely (1) rubber tires and inner tubes, (2) rubber boots and shoes, and (3) other rubber goods, as rubber belting and hose, rubberized fabric, reclaimed rubber, rubber heels and soles, and hard rubber goods. In 1929 the

first group comprised 69%, the second 9%, and the third 22%, of the total output. Ohio stood first among the states in rubber manufactures, producing 48% of the total for the United States and 65% of the rubber tires and inner tubes made in the country. Massachusetts ranked second, producing 7% of the total and 40% of the rubber boots and shoes. Among other leading states were California, New Jersey and Wisconsin.

RUBBER MANUFACTURES, U.S., 1914-1929

Year	No Estab- lishments	Wage Earners	Wages \$	Value of Products \$
1914	342	74,022	44,167,402	300,993,796
1919	477	158,549	193,763,089	1,138,216,019
1925	530	141,869	191,285,520	1,260,805,063
1929	525	149,148	207,305,857	1,117,460,252

For additional details see the sections on Manufactures in the articles on the various states.

RUBBER, SYNTHETIC, a rubber-like material obtained by the polymerization of ISOPRENE, or compounds chemically similar to isoprene, such as butadiene or dimethylbutadiene. The most commonly used agents of polymerization are heat, strong acids and alkaline metals. They give slightly different synthetic rubbers. Synthetic rubber should designate only polymerized isoprene, while polymerized dimethyl butadiene should be termed "methyl-rubber." In common usage, the first appellation covers both compounds. Synthetic rubber and natural rubber exhibit the same chemical properties; they are soluble, or swell, in the same solvents, but to different degrees; they are thrown out of solution by the same precipitating agents, but to different extents. Synthetic rubber is vulcanized by the same method as natural rubber, but it never acquires the tensile strength and elasticity of the natural product. Aging or oxidation deteriorate the artificial rubbers faster and more completely. Only negligible amounts of isoprene rubber have been used in commercial applications, due to the poor qualities of the finished goods, and the exorbitant cost of isoprene. Several tons of methyl-rubber tires were made in Germany at the time of the world war, but this was justified only by the fact that the supply of natural rubber was entirely exhausted in that country. See also PLASTICS.

A. L. H.

RUBBER PRODUCTS. Crude rubber can be softened by heat and by mechanical action. When heated with sulphur and certain other substances (see RUBBER ACCELERATORS) it undergoes a change, known as VULCANIZATION, by which it becomes less plastic and more elastic, harder, less affected by heat, cold and organic liquids such as oils. The application of these two principles forms the basis of most rubber manufacture as it is carried out at the present time. The enormous variety and amount of products made from rubber are explained by the remarkable properties of vulcanized rubber. It combines to a far greater extent than any other material the useful properties of strength, extensibility, resistance to cutting and abra-

sion, ability to withstand repeated bending and stretching, and to resist chemicals. There is no other material whose physical properties can be so widely and yet so precisely modified by manufacturing processes.

A typical rubber manufacturing process involves the following steps:

1. The crude rubber is softened, by grinding between two large horizontally mounted steel rolls (up to 84 inches in length and 20 inches diameter).

2. To this softened rubber are added various ingredients including: (a) sulphur and accelerators and antioxidants to produce vulcanization and retard deterioration in use; (b) ingredients known as fillers to toughen and otherwise modify the properties of the finished product, (c) softeners, such as oils, tars and pitches to facilitate the later handling of the mixture and to improve the dispersion of the fillers in the rubber, and (d) coloring agents. This step is called mixing.

3. The mixture prepared as above, frequently called the compound, is now converted into a convenient form for the fabrication of the article. One way is to pass it between sets of heated rolls called calenders (arranged one above the other in this case) to produce a smooth sheet of the desired thickness. In many cases this sheet is applied to fabric in the same operation.

Another method is to force the rubber through a machine resembling a meat chopper, called a tubing machine; this produces continuous rods, tubes, or thick strips.

4. Many rubber articles are made by cutting pieces of the calendered or tubed stock to proper size and shape, placing these pieces in molds or dies. These molds are then placed between the heated plates of a press, usually hydraulic, and heated in this way for a predetermined period (usually 10 to 60 minutes). This brings about vulcanization. Rubber heels and many other articles are made in this way.

In other cases the article is partly or entirely constructed before molding or vulcanizing. Rubber footwear is built up largely by hand on forms or lasts, which are then placed in heated chambers to vulcanize the article. Tires are made by building up a flat circular band of fabric coated with rubber. To this band a heavy strip of rubber known as the tread is applied. The band is then forced into a shape approximating that of a tire and vulcanized in a mold. Pressure is applied to the interior of the tire while it is vulcanizing in order to force it against the interior faces of the mold. More recently processes have been developed for the manufacture of rubber goods direct from latex, without going through the step of preparing crude rubber in bulk form.

W. A. G.

RUBBLE, a term applied to MASONRY composed of stones of irregular size and shape bonded together with MORTAR.

RUBELLA, or "GERMAN MEASLES," a mild, acute, infectious disease of childhood, closely resembling in its symptoms MEASLES and light attacks of SCARLET FEVER. About two weeks after being exposed,

the child develops a red eruption on the face and upper part of the body. The spots are small, pink, and slightly raised. There are no other symptoms except a slight fever and enlarged nodes at the back of the neck. No treatment is required, but the child should be kept at home for three weeks.

Rubella has only recently been distinguished as a separate disease. The location of the eruption on the face helps to distinguish it from scarlet fever; while the absence of the characteristic white specks in the mouth enables one to distinguish it from measles.

RUBENS, PETER PAUL (1577-1640), the greatest painter of the Flemish School, was born at Siegen, in Westphalia, June 29, 1577. Although intended for the law, the boy's taste for art was pronounced and he was allowed to follow a painter's career, studying with various masters at Antwerp where his family had removed after the death of his father. In 1600 he went to Italy and entered the service of the Duke of Mantua as court painter. After 8 years he returned to Antwerp, called back by the serious illness of his mother. It had been his intention to return to Mantua, but when the Governor of the Netherlands offered him the post of court painter, Rubens accepted, married Isabella Brant, his first wife, the next year, built himself a palace and lived like a great noble. He was the rare combination of artist and diplomat and in the latter capacity was sent on missions to foreign courts where he proved to be as brilliant in politics as he was in art. Charles I of England and Philip IV of Spain honored him with decorations and his fame as a great personage spread throughout Europe. Isabella his wife having died, he married in 1630 Helene Fourment, a beautiful girl of 16, whose portrait he painted a number of times. Rubens died at Antwerp, May 30, 1640, and was buried with great ceremony in the church of Saint Jacques. The amount of work accomplished by this wonderful man is amazing as there are several thousand pictures by him, though he was of course helped by pupils. He seemed to revel in the manipulation of color, painting with a directness that never grows monotonous or facile. There was a strain of healthy coarseness in his art, possibly the expression of the man's animal spirits. Even in his early works this robustness is present. Some of the pleasure to be found in Rubens is derived from the artist's own enjoyment in his work. In the *Marie de' Medici* canvases, in the Louvre, the pigment seems to have been laid on in the most effortless way and never touched again. He is seen to the best advantage at Antwerp where his masterpiece, *The Descent from the Cross*, hangs in the cathedral.

RUBEZAH or Number Nip, in German legends, a goblin or mountain spirit supposed to dwell in the Riesen-Gebirge, Silesia. Lord of the weather, he can assume many different shapes, but appears most frequently as a monk in a gray cowl, carrying a stringed instrument which he can strike and cause thunder.

RUBICON, one of the lesser rivers of Italy flowing into the Adriatic. It became important as the

boundary line between ancient Italy and Cisalpine Gaul. Thus when Caesar crossed it the act had some significance, equivalent to a declaration of war on the Senate. To "cross the Rubicon" has thus become a proverbial expression. There is some uncertainty as to the identification of the modern stream corresponding to the Rubicon.

RUBIDIUM, a chemical element belonging to the group of the alkali metals discovered in 1860 by Bunsen and Kirchhoff by spectroscopic methods. Its chemical symbol is Rb, its atomic weight 85.44. It occurs widely distributed in nature, though usually in very small amounts; traces of it are present in tea, coffee, cocoa and tobacco.

RUBIDOUX, MOUNT, an abrupt rocky hill which rises from the Santa Ana valley at Riverside, Cal. The summit is reached by a narrow automobile road and is the site of a cross dedicated to Father Junipero Serra, the heroic Franciscan of the early mission days in California. On Easter Sunday an impressive sunrise service is held on the summit of Mt. Rubidoux, which is attended by many thousands of people.

RUBINSTEIN, ANTON GREGOR (1830-94), Russian composer and pianist, was born at Wechotynetz, Nov. 28, 1830, of Jewish parentage. He made his first concert tour in 1840, in which year he continued studies under Liszt. He returned to Russia in 1848, accepting a court appointment. In 1862 he founded the St. Petersburg Conservatory, of which he was first director, and he fulfilled every duty of his position although engrossed by numerous European and American tours. As a composer he is in legitimate descent from MENDELSSOHN, but his ease and fluency in composing proved detrimental to the survival of much of his work, which included operas, symphonies, pianoforte pieces, oratorios, and songs. Of his operas *Feramore* and *The Demon* are the best known. He died at Peterhof, Nov. 20, 1894.

RUBIO, PASCUAL ORTIZ. See ORTIZ RUBIO, PASCUAL.

RUBLE, a silver coin and monetary unit of the Union of Socialist Soviet Republic (U.S.S.R.) equal to one-tenth of the CHERNOVETZ; and equivalent to 51½ cents at par. It is divided into 100 KOPECKS. A paper ruble which was in circulation before the World War suffered tremendous depreciation, and in 1923, following the establishment of the chernovetz in 1922, it was replaced by the Soviet ruble, also a paper currency. The Soviet ruble was later sacrificed to save the chernovetz and in 1924 currency ruble notes were issued and made legal tender, their circulation being limited to maintain their value.

RUBRIC (Latin *rubrica*, written in red), a rule or regulation relating to the order of the liturgy, as printed in the MISSAL, BREVARY, RITUAL and Prayer Book.

RUBUS, an important genus of shrubby plants of the rose family, collectively called brambles, including many valuable bush fruits, as raspberries, blackberries, and dewberries. There are probably 500 species and



“ALTARPIECE OF ST. ILDEFONSUS”

By Peter Paul Rubens (1577-1640). In the center is Mary with four holy women holding a chasuble for St. Ildefonsus to kiss; on the left, Archduke Albert, Stadtholder of The Netherlands, with St. Albert of Brussels; on the right, Isabella Clara Eugenia, his wife, with St. Elizabeth. In the Art History Museum, Vienna.

important subspecies. They are found widely throughout the world but occur most numerous in the Northern Hemisphere; some 40 are native to North America. They are mostly shrubs with erect, recurved, somewhat climbing or trailing stems, alternate leaves and white, pink or rose-colored flowers. The fruit, popularly called a berry, is an aggregate of many one-seeded drupelets.

Besides the raspberries, blackberries and dewberries, both wild and cultivated, the group includes the flowering RASPBERRY (*R. odoratus*), the wineberry (*R. phænicolasius*), the mayberry (*R. palmatus*), the strawberry-raspberry (*R. illecebrosus*) and the Himalayaberry (*R. procerus*), more or less planted for ornament. See also BLACKBERRY; DEWBERRY; LOGANBERRY; SALMONBERRY.

RUBY, a transparent, red variety of CORUNDUM, one of the most PRECIOUS STONES known. The ruby is valued on account of its color, for it has weak dispersion, hence but little "fire," and low refractivity, so is not very brilliant. The color varies from rose, through carmine, to dark purplish red. "Pigeon's blood red" is the most highly valued shade. PLEOCHROISM is marked, the mineral showing pale red in one direction and dark red at right angles to it. For this reason the ruby must be cut with the table parallel to the basal face of the crystal in order to get the best colors. It crystallizes in the HEXAGONAL SYSTEM. Chemically it is aluminium oxide. When pure, this compound is colorless; the ruby red is due to small amounts of chromium.

Some stones show asterism, a six-rayed star appearing in luminous white within the crystal. This is caused either by microscopic inclusions regularly arranged, or by a lattice structure in the crystal. To show this, the stone must be cut en cabochon. It is then called a star ruby. Other cuts are step, and brilliant.

Rubies are found in placer deposits, and in metamorphic limestone, gneiss, schist, granite, syenite and peridotite. They are mined from small open pits, the excavated materials being washed free of valueless dirt and gravel. The best stones are mined in upper Burma, where they are found in limestone and in sand, gravel, and soil placers. Many come from Siam, where they usually occur with SAPPHIRES, the blue variety of corundum. In the United States, rubies are mined in North Carolina and Montana.

Aside from use as gems, rubies are also employed as bearings in fine watches and scientific instruments. Artificial rubies have become popular in recent years. See also GEM STONES; MINERALOGY; METAMORPHISM; GEOCHEMISTRY. S. F. K.

BIBLIOGRAPHY.—George F. Kunz, *The Curious Lore of Precious Stones*, 1913; E. H. Kraus and E. F. Holden, *Gems and Gem Materials*, 1925.

RÜCKERT, FRIEDRICH (1788-1866), German poet and Orientalist, was born at Schweinfurt, Bavaria, May 16, 1788. After studying at Würzburg and Heidelberg he became Professor of Oriental Languages at Erlangen, 1817-26. He acted as privy

councilor for Frederick II at Berlin in 1841-48, after which he retired to private life. Rückert's literary activity commenced with *Poems*, 1814, containing his famous sonnets against Napoleon. His later works were connected chiefly with his Oriental studies and translations, his most learned work being the *Wisdom of the Brahmins*, 1836-39. His works were finally collected in 12 volumes. Rückert died at Neuses, near Coburg, Jan. 31, 1866.

RUDAGI, FARIDEDDIN MOHAMMED (c. 885-954), Persian poet, was born at Rudag, Transoxiana, about 885. He is the first of the noted predecessors of FIRDUSI and is sometimes called the "father of Persian literature." Only a few specimens of his epics and a number of lyrics have survived. His simple style shows traces of religious Sufism. Attributed to him is the Mohammedan custom of arranging a poet's work in alphabetical order called the *diwan*. At least a part of his life he was blind, and his later years were passed in obscurity and neglect. Rudagi died in 954.

RUDBECKIA, a genus of coarse summer-flowering herbs of the composite family, many of which are commonly called coneflower. There are about 30 species native to North America, several of which are cultivated for their showy flowers. They are mostly vigorous perennials bearing large, entire divided leaves and long-stalked flower-heads with bright yellow rays and a more or less cone-shaped yellowish or purplish-black center. Among the best known are the BROWN-EYED SUSAN (*R. triloba*), the BLACK-EYED SUSAN (*R. hirta*) and the GOLDEN-GLOW (*R. laciniata* var. *hortensia*).

RUDDER, a flat wood or metal structure attached vertically to the rudder post of a vessel for changing her direction when underway. Rudders are used for the same purpose on airships, but here they are lightly built of canvas and wood and operated by levers. In small craft as motor boats, schooners and the like, the rudder is turned by a tiller or hand steering wheel, while in large vessels steam, electric, hydraulic or a combination of electric and hydraulic power is used in connection with a centralized control mechanism.

The area and shape of the rudder depend on the size and type of the vessel it is installed on. On a tug boat, the maximum width is near the surface of the water decreasing as the depth increases, while for cargo and passenger vessels, the width may be the same at the top as at the bottom, or on special types of stern construction a balanced rudder, i.e., with surfaces forward and aft of the rudder stock is used.

Rudders may have a steel forging or casting for a frame to which is riveted a heavy steel plate. The frame has pintles that are supported by bushings in the rudder post of the vessel. The top of the frame is called the rudder stock, to which is fastened the tiller or quadrant for operating it.

BIBLIOGRAPHY.—A. C. Holmes, *Practical Shipbuilding*.

RUDDER FISH, a name applied to various spiny-rayed fishes which follow vessels at sea, especially to the black rudder fish (*Palinurichthys perciformis*)

found off the Atlantic coast from Cape Hatteras to Nova Scotia. It is somewhat less than a foot long, blackish or greenish in color, marked with darker dots and bars, and is excellent eating. From its habit of frequenting floating logs and barrels in the search of barnacles, it is known also as logfish and barrelfish. The name rudder fish is sometimes given to the shark pilot (*Seriola zonata*) of the Atlantic coast and to the pilotfish (*Naucrates ductor*), of warm off-shore waters, both belonging to the POMFANO family (*Carangidae*).

RUDOLPH II (1552-1612), Holy Roman Emperor, was born at Vienna, July 18, 1552. Crowned King of Hungary in 1572, and King of Bohemia and German king in 1575, he succeeded his father, Maximilian II, as emperor in 1576. In 1608 his brother Matthias seized upon Rudolph's projected campaign against the Turks as a cause for opposition and found so many followers that he was able to enforce his demands for Austria, Hungary and Moravia. In 1611 Bohemia also went under the rule of Matthias. He died at Prague, Jan. 20, 1612.

RUE (*Ruta graveolens*), a bitter, heavy-scented, perennial of the rue family (*Rutaceae*). It is a native of southern Europe widely cultivated in gardens and sparingly naturalized in the eastern United States. The smooth, erect, sometimes slightly woody stem, 1 to 3 ft. high, bears much divided leaves, small, yellowish flowers in terminal clusters and a four or five-lobed seed pod (capsule). The strong odor and highly acrid taste of the plant are due to the presence of a volatile oil. Rue was used medicinally in ancient times and especially in the Middle Ages as a stimulant, irritant and narcotic drug. From association with "rue," signifying sorrow or contrition, the plant became known as herb-of-grace, a symbol of repentance and humility.

RUE ANEMONE (*Syndesmon thalictroides*), a delicate perennial herb of the crowfoot family, sometimes called mayflower and wind-flower. It is an attractive early wild flower blossoming from March to June in woodlands from New Hampshire to Minnesota and southward to Florida and Kansas. The plant, rising from tuberous roots, grows 4 to 9 in. high bearing leaves of numerous leaflets, resembling those of the meadow rue, and white or pinkish flowers about an inch broad.

RUFF (*Philomachus pugnax*), an Old World wading bird allied to the sandpipers, highly esteemed for its flesh. The male is about a foot long, and, during the breeding season, mottled black, buff and gray above and whitish below, with yellow caruncles on the face and a large frill of feathers about the neck, which varies in color with different birds from white to brown or black. The female, known as reeve, is slightly smaller with barred upperparts and pure white underparts. The ruff frequents marshes, breeding in temperate Europe and Asia, and wintering as far southward as Africa, India and Malaya. It feeds chiefly on worms and insects and nests usually in a hollow in the ground, laying four or five speckled, greenish eggs. The males, which are greatly exceeded

in numbers by the females, are polygamous and pugnacious, fighting fiercely among themselves and having certain spots to which they repair year after year for their sparring matches.



RUFF

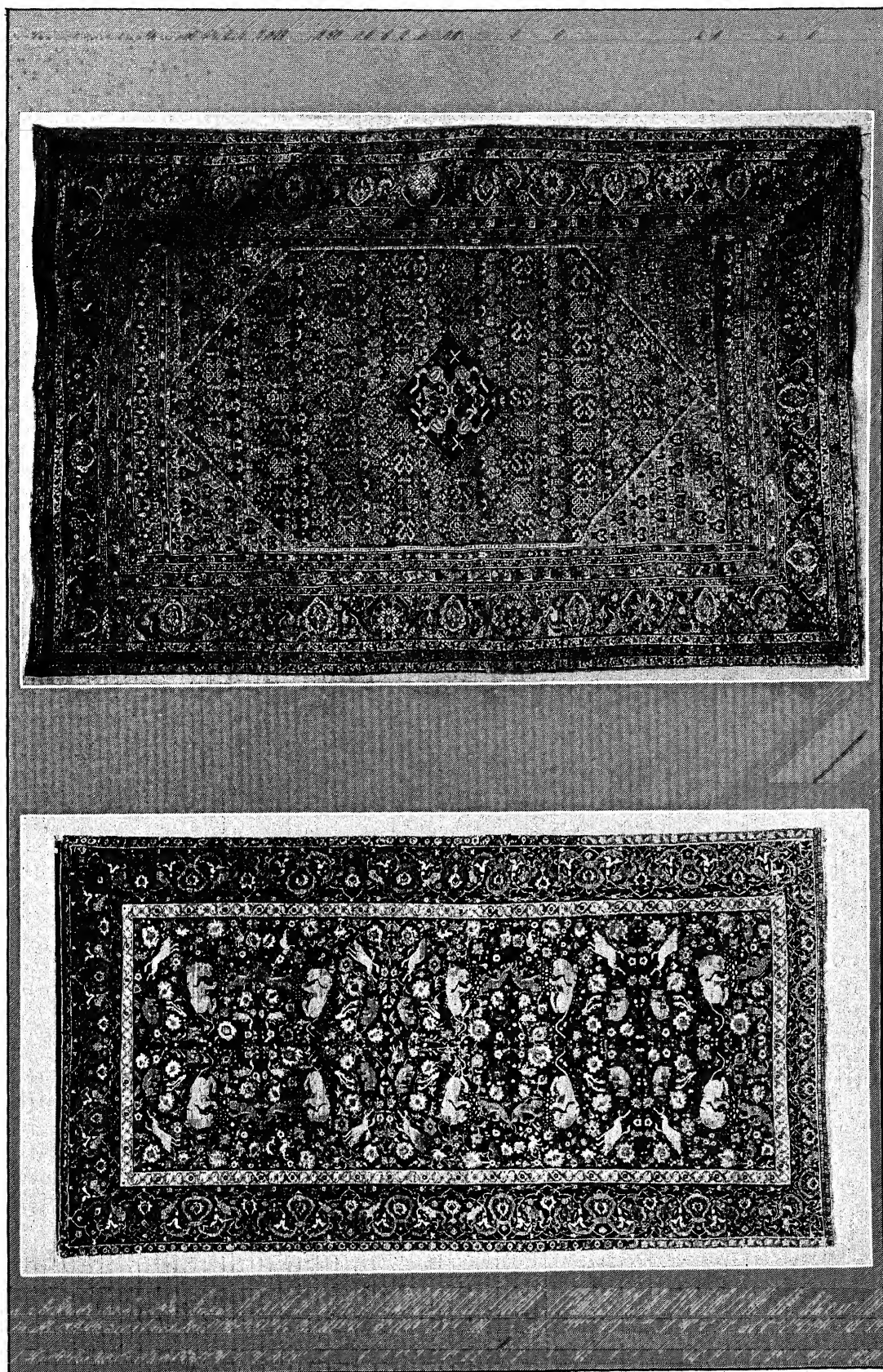
RUFFO, TITTA, (1877-), Italian baritone, was born at Pisa, June 9, 1877. Rejected by the Rome Conservatory, he studied at Milan with R. Cassini, eventually making his debut in 1898 at Rome as Herald in *Lohengrin*. His subsequent success was notable in all the chief cities of Europe and the Americas. He has appeared with the Chicago Civic and the Metropolitan Opera companies. In 1928 he began to sing for the sound films.

RUGBY, a market town of Warwickshire, England, lying on tableland at the south bank of the Avon near the Oxford Canal, about 82 mi. northwest of London. An ancient town near which have been discovered prehistoric tumuli, it is particularly famed for the school founded in 1567. Matthew Arnold and Rupert Brooke are among its famous alumni, as well as William Webb Ellis who is credited with originating modern Rugby football in 1823. The rebuilt parish church of Rugby boasts a 12th century chancel, and to the north is the traceable site of a small Norman castle. The town is a railway center of some importance, and holds cattle, sheep and horse fairs. Pop. (of town and district) 1921, 19,331; 1931, 21,683.

RUGBY SCHOOL, a noted boys' school at Rugby, Warwickshire, England. It was founded under the will of Laurence Sheriff (d. 1567), which provided an endowment amounting ultimately to £5,000 yearly. The full sum was not obtained until 1653 because of various lawsuits. Most of the present buildings were designed by Henry Hakewill and date from 1809. A tablet on the Doctor's Wall commemorates the origin of Rugby football, 1823, and there is a statue to Thomas Brown, creator of TOM BROWN. Rugby's most famous headmaster, 1828-42, was Dr. Thomas Arnold. The student enrollment is annually about 600. In 1931 the headmaster was W. W. Vaughan.

RUGS AND CARPETS. The making of floor coverings, like all other weaving, is a craft of ancient

RUGS AND CARPETS



COURTESY METROPOLITAN MUSEUM OF ART

TWO NOTABLE EXAMPLES OF ORIENTAL RUG WEAVING

1. 16th century Persian rug from Tabriz, with an animal and floral design on a claret-colored background. 2. Ghiorde rug from Asia Minor. 17th-18th centuries.

origin, and is known to have flourished before the beginning of the Christian era. The first rugs and carpets were made in the Orient, on the simplest of hand looms. The best are still produced there, on the same kind of loom and by the same methods, the same traditions even being followed in most details.

A number of distinctions and classifications exist among floor coverings, but a difference between "rug" and "carpet" is not one of them. Rugs and carpets differ only in size, and perhaps in pattern arrangement to meet size differences. As a rule the best Oriental rugs are fairly small, that is to say, are rugs and not carpets; but not infrequently the rule meets with exceptions.

The first real distinction among Oriental floor coverings divides them into two classes, pile rugs and tapestry rugs, the first class being very much larger, including as it does almost all rugs and carpets put to practical use to cover the floor. Both groups are woven by the usual darning method of interlaced warp and weft threads, and most rugs are woven on upright looms, in which the weft is inserted horizontally on a vertical warp. The majority of floor coverings are woven with a pile made of knots tied to the foundation threads in such a way that the ends will stand up and form a thick nap; a row of knots is fastened to the warp threads, a row or more of weft is added, then another row of knots, and so on until the rug is finished. Oriental tapestry rugs, known as *khlims*, and the flat *soumak* rugs woven by a modified tapestry method, are of course somewhat finer than the pile rugs. Such rugs as the American hooked and braided rugs, which are in a class by themselves, are not for the moment under consideration.

Pile rugs, again, are divided into two classes, the grouping of which is based upon the kind of knot used. Every Oriental rug is knotted in one of two ways; by the *Ghiordes* or Turkish knot, or by the *Sehna* or Persian knot. The knots are made over two warp threads. The two methods differ in the looping of the second thread. The Spanish knot, looped over one thread only, is not used in the Orient.

The many other distinctions among Oriental rugs rest upon differences in treatment. The most important of these is in the matter of texture. The coarseness or fineness of a rug depends upon the number of threads tied in to make the pile, or in other words, the number of knots to the sq. in. This ranges from about 15 to more than 1,000, although the latter is extremely rare; the general range runs to about 400 knots per sq. in.; from 40 to 80 knots makes a medium texture. The closeness with which the pile is cut, to short and hard, or long and heavy, is also important. The material is naturally another field, and a wide one, for differences among rugs: the warp may be of cotton, linen or wool; the weft thread may also vary, since the pile may use wool, silk, camels' hair or goats' hair, very often one of the two last-named being knotted in with wool. Also different varieties of wool are used. Another distinction lies in the number of weft threads introduced between

the rows of knots. Then there are the differences of pattern and of color by which the more or less uninitiated usually identify the various groups.

These groups are named for the localities from which they come. The different places, peoples and nomadic tribes have their traditional methods and patterns, their age-old customs in regard to knot, texture, material and color, from which even now most of them vary only a little. There are far too many of these classifications even to be listed here, much less described; Mumford's textile table notes 54 different kinds of Oriental rugs, and he does not include Chinese or Indian rugs in his list. The following is a brief mention of some of the best-known and most important types of Oriental rugs in the principal subdivisions of the major groups.

The major groups are properly four: Persian, Turcoman, Caucasian and Turkish. Chinese rugs are generally classed by themselves. Indian rug-making is for the most part modern, and is not indigenous.

Persian rugs have always been, and still are, the finest made. In old Persian rugs the *Sehna* knot was always used, but in later rugs the *Ghiordes* knot is found in some localities. The decoration usually follows some form of graceful all-over pattern, frequently floriated, often with medallions, and the colors are rich and soft. Among the finest of the Persian rugs are those known as *Kermanshah*, which not infrequently have more than 400 knots to the sq. in.; the old rugs of Tabriz, which were very beautiful, and the rugs of Kirman, are often called *Kermanshah*, but present-day Tabriz rugs are a commercial manufacture. The *Sehna* rug is another highly valued Persian product and one of the most expensive of Oriental rugs; it uses among other designs the traditional pattern figures known as "the fish" and "the pear," and is made in beautiful blues and reds, ivory and yellow. The *Sehna* rug has a short pile, as has another favorite rug with a fine, hard texture, the *Feraghan*; this is made on a cotton warp and usually with a cotton weft, uses the *Ghiordes* knot and has graceful unobtrusive patterns in soft colors. The *Kashan* rug is considered the finest woven to-day. Its pile is finely made of Australian wool or silk, and it is very thick and soft; the patterns are usually floral. The *Kurd* rugs are heavy and durable, and have medallion patterns on a ground of red or blue.

The best-known and the best Turcoman rugs are the beautiful deep-toned fabrics which we call *Bokhara*, often made with 400 knots to the sq. in.; they should be called *Tekke*, but we have known them as Bokhara so long that it would be too confusing to try to correct the error. Their rich maroon or crimson ground and their square and oblong figures place them among the most easily recognizable of all Oriental rugs. Like most Turcoman rugs they use the *Sehna* knot. Next to the Bokhara, the best-known rug of this general group is the *Beluchistan*, which has a coarser fabric and greater variation in figuring, and also uses a red ground. Turcoman rugs generally use geometrical figures in their design.

This is also a distinguishing feature of the rugs of the Caucasus. They have a lighter ground than the Turcoman rugs, and on this their sharp designs stand out in noticeable contrast to the more profuse curved figures of the Persian carpets. Almost all Caucasian rugs are made with woolen warps. The best are the rugs known as *Daghestan*, which are made with lambs' wool; they are always small, with mosaic-like patterns. A very popular Caucasian rug is the *Kazak*, less fine, but rich and durable. It often uses as many as four weft threads after every row of knots. The *Shivan*, fairly fine in texture and made with a short pile, is another important Caucasian rug. Caucasian rug-makers use the Ghiordes knot entirely, like the Turks.

Turkish rugs, too, are almost all made with woolen warps. In the modern *Komeh*, which is usually strictly a carpet, the warp is particolored. The ancient *Ghiordes* rugs are considered the equal of the old Persians, and resemble them in their floral designs, but the modern Ghiordes has not kept closely to its old traditions. Most Ghiordes rugs are small, fine in texture and in pattern. The *Bergamo* rugs are very good; they are square rugs, and use a colored warp and weft which deepens their tone. The rugs known generally as *Smyrna* are a modern commercial product.

Chinese rugs are easily distinguishable, with their solid backgrounds of soft blue, rose, gold or tan, and their curious animal or symbolic figures standing out with almost the effect of something appliquéd on the fabric. They are of looser weave than most Oriental rugs.

Rug-making was introduced into Europe by the Moors but was not generally practised until the 17th century, which was a time of flourishing development for the craft in western Europe. The famous Savonnerie and Aubusson manufactories were established in France during that period. In nearly every country of Europe some floor coverings are still made by hand, and the 20th century has seen a marked revival in this craft. France, England, Sweden, Norway, Finland, Poland and Czechoslovakia may be especially mentioned for their handmade rug industry. Much study is devoted to modern design. In the United States hooked rugs, braided rugs and handwoven rag rugs were made in colonial days, and this craft, too, has been revived in recent years. The hooked rug, with a pile hooked through a cloth foundation, is especially popular. Modern handwoven rugs are also made in the United States. X.

Machine Made Carpets consist of three principal types, as follows. (1) Those in which the design is produced by jacquard mechanism. These include Wilton, Brussels and certain types of Axminsters, all having pile surfaces; and Ingrain carpets, which are flat and pileless. (2) Those which are made without the aid of jacquard mechanism, e.g., Chenille and Royal Axminster. (3) Those on which the pattern is printed either on the yarn, before being woven or on the carpet, after weaving, by means of

block printing. The principal types of these carpets are known as tapestries and velvets—the former having a round, uncut pile, and the latter a cut pile.

Brussels carpets were first developed by a Belgian weaver, about 1750, and shortly afterwards were introduced in England. Of late years this type of carpeting, after a long run of commercial prosperity, has lost its popularity because of its relatively high cost and limited style appeal.

Wilton carpets are manufactured along the same general principles as Brussels, but the Wilton weave has a cut pile more generous in height and more luxurious in effect. From Wilton looms come very meritorious reproductions of oriental designs as well as conventional effects.

Ingrain carpet is practically passé, as its flat weave does not resist hard wear to the same extent as other more appealing carpets, such as Wiltons and Axminsters.

Chenille carpet's distinctive feature is the preparation of its pile in the form of a long chain of fur, in which each separate tuft may be a distinct color from the rest, thus affording practically unlimited design and color latitude.

Royal Axminster carpet, the product of an American invention, is the most widely used floor covering fabric in America at this time, and is also manufactured in large volume in Europe. With the Axminster weave, all of the dyed pile yarn processed is shown in the face of the carpet, none wastefully floating in the back of the carpet, as in the case of the Wilton constructions.

Tapestry and velvet carpets have declined in popularity during the past five years, owing to the more favorable acceptance of Axminster weaves. In that interval velvet types of looms have been turned to the manufacture of plain velvet carpet termed Broadloom, and this weave has been improved and developed so that it is now available in substantial constructions up to 18 ft. seamless.

A comparative summary in square yards of carpet manufactured in the United States for two representative years is shown below:

	1929	1927
Axminster	29,042,147	24,831,411
Wilton	9,677,178	10,266,199
Velvet	21,047,658	16,337,024
Tapestry	4,733,636	6,796,850
Chenille	546,340	329,178
Others	8,090,337	8,632,273
Total	73,137,294	67,192,933

H. E. W.

BIBLIOGRAPHY.—H. Clark, *Bokhara, Turcoman and Afghan Rugs*, 1923; R. Beaumont, *Carpets and Rugs*, 1924; R. B. Holt, *Rugs, Oriental and Occidental*, 1927.

RUHR, THE, a district in the province of Westphalia, Germany, deriving its name from a river which flows into the Rhine at Ruhrort. This area of somewhat more than 40,000 sq. km., with a population of 4,000,000, is the source of four-fifths of the

iron and coal production of Germany and supplies almost three-fourths of the traffic of the German railroads. It is justly, therefore, regarded as the principal nerve center of industrial Germany. The Ruhr became a burning diplomatic question when, in default of full German reparations payments, it was occupied by French and Belgian forces in 1923.

Prior to the Versailles settlement of 1919 there had existed close economic interdependence between the iron industry of Lorraine and the coal mining industry of the Ruhr. After the cession of Lorraine to France the former continued dependent upon Ruhr coke. Foreseeing this situation, the Treaty of Versailles had guaranteed to France a regular supply of coal and coke from the Ruhr. When in 1920 German deliveries fell short, the Allies threatened the occupation of the Ruhr. The threat alone was sufficient to produce the desired results. In the perennial reparations contests France actually did occupy about one-eighth part of the Ruhr in the following year.

The French people, feeling the vanquished Germans to be less heavily burdened than themselves, and convinced that the Germans were striving to evade their obligations, lost patience when the year 1922 revealed deficiencies in lumber and coal deliveries. M. Poincaré, as head of the Government, resolved upon a policy of force. Germany was lacking only in the will to pay, he announced; force would supply that will. In Dec. 1922 the Reparations Commission acting under French influence duly declared Germany in default. According to the terms of the treaty, in case of voluntary default the Allies might take economic and financial reprisals, and such other measures as they decided were necessary. On Jan. 11, 1923, French and Belgian troops entered the Ruhr.

The German contention was that the default was involuntary and moreover that France and Belgium were not warranted in taking action alone, but must act in concert with the other allied governments. The British government held the view that the action of France was not justified by the treaty and proposed arbitration. The day following the entry of foreign troops into the Ruhr the German government issued a formal protest, ordered the cessation of all reparations payments to the French and Belgians, and forbade civil employees to obey the invaders. The German people of the occupied area loyally accepted a passive resistance policy, in which they received the encouragement of the Berlin government. France and Belgium retaliated by sending in more troops, severely punishing offenders, separating the Ruhr economically from the rest of Germany.

Germany, stricken as she was with industrial paralysis, suffered far more than France. German credit which had declined sharply during the preceding year was now completely shattered, and in July after six months of passive resistance, a new German government headed by Stresemann agreed to make a complete surrender. But for some time the French gov-

ernment refused to deal with the German government, and instead made a series of agreements in Nov. 1923 with the important local industries of the Ruhr, whereby the latter pledged to deliver certain products regularly to the invaders. Finally British and American pressure induced France to agree to the appointment of the Dawes Commission, and following the signing of the DAWES PLAN, Aug. 1924, the French gradually restored control of the Ruhr to Germany, the last troops being withdrawn in Aug. 1925.

The occupation of the Ruhr did finally lead to complicated agreements between Germany and France concerning their coal and iron supplies, but at a heavy cost. The occupation rendered reparations payments more difficult than ever. It was the decisive factor in the complete financial collapse of Germany which led to depression in other countries, notably in France itself. The operations had cost considerable money and some loss of life. And by no means the least significant result of the Ruhr occupation was the violent hatred of the French engendered among the Germans. E. F. C.

RUHRORT, a city formerly in the Prussian Rhine province, but since the consolidation with Duisburg and Meiderich in 1905, Duisburg-Ruhrort, a district of the city of Duisburg. It is the center of a large iron and steel industry, and the Duisburg-Ruhrort harbor is the largest interior port in Europe. Coal is shipped to South Germany, Belgium, Holland and overseas. The leading imports are iron ore from Spain, Sweden, Italy and Canada. Ruhrort has a number of trade schools. First mentioned in the 14th century, it was destroyed 1636 by the Elector of Brandenburg to avoid its being used strategically by the Spaniards and Dutch. The city fell to Brandenburg, 1614. Pop. 1925, 41,416.

RUISDAEL, JACOB. See RUYSDAEL, JACOB VAN.

RULE OF THREE, a rule for finding the missing term of a proportion when three terms are known. For example, if $x:4=7:3\frac{1}{2}$, then the rule may be expressed as $4 \times 7 \div 3\frac{1}{2}$, which is equal to 8. In the Middle Ages commercial problems were commonly solved by this rule. It seems to have arisen in India, to have been passed on to the Arabs, and thence to the Italian merchants under the name, with variants, of *La regola de le tre cose*. The Germans of the 15th century called it the *Regel de Tri*, or *Regeldetri*. As stated in the 16th century English books, "Multiply the last number by the seconde, and diuide the Product by the first number." It was also known as the merchants' rule (*Regula mercatorum*) and as the golden rule (*Regula aurea*). It was extensively used in the United States until about the middle of the 19th century, and is still used in certain other countries. See PROPORTION.

RULES COMMITTEE. See CONGRESS OF THE UNITED STATES.

RUM, ROMANISM AND REBELLION, a phrase derogatively characterizing the chief elements of the Democratic party, spoken by the Rev. Samuel

D. Burchard, pastor of the Houston Street Presbyterian Church, New York City, on Oct. 29, 1884. The phrase occurred toward the close of an address to JAMES G. BLAINE, Republican candidate for president, by the Rev. Mr. Burchard as spokesman for a large party of clergymen of all denominations, assuring Blaine of their support. Blaine did not realize the baleful potentialities of the phrase, and did not at the time repudiate it. The Democrats distributed leaflets with ringing charges upon the insulting alliteration; and the phrase may have alienated from the Republicans enough Catholic voters in New York State to give the electoral vote of that state, and consequently the presidency, to Blaine's opponent, Cleveland.

RUM, RUMI, terms used by Near Eastern Moslems to designate Constantinople (successor of Rome) and the Byzantines. More particularly, they refer to a state set up in 1077 by the Saljuq Turks about Iconium (Rum), in Asia Minor, from which the Byzantines (Rumis) had been dislodged. This Saljuqid state of Rum survived until the Osmanlı Turks assumed control of Asia Minor around 1300. The famous mystic, Jalalu 'd-din Rumi, founder of the Mevlevi order of dervishes, was a citizen of Rum.

RUMANIA or **ROUMANIA**, also Romania, a kingdom of southeastern Europe, comprising an area of 122,282 sq. mi., about 29,500,000 hectares. To the east it is bounded by the Black Sea; in the north-east, just south of Odessa at the mouth of the Dniester River, begins the frontier with Russia, following the course of the Dniester to the Polish frontier near the town of Khotin. From here the frontier between Poland and Rumania proceeds westward, leaving the towns of Zalesiki and Sniatyn in Polish territory. Czechoslovakia juts between Poland and Hungary and forms the remaining stretch of Rumania's northern frontier. The entire northwest side of Rumania is bounded by Hungary, the boundary running almost in a straight line from Nagy-Szolos in the north to the Hungarian town of Mako in the south. The boundary between Yugoslavia and Rumania begins at this point, zigzagging southward till it reaches the Danube at the Iron Gates. Flowing directly eastward from Yugoslavia, the Danube at this point makes a great bend and courses southward, dividing Rumania from Yugoslavia until the Bulgarian border is reached near the Serbian town of Negotin. For the rest of its eastward course, from Negotin to Turtukai, the great river is the frontier between Rumania and Bulgaria. At Turtakia the border line between these countries leaves the Danube and turns sharply south, ending at the Black Sea between the towns of Varna and Baltchik. Rumania is thus bounded by one sea and the frontiers of six countries.

Surface Features. By the World War peace treaties Rumania was enlarged to more than twice its pre-war size. Transylvania, the Banat and Bukovina in the north were acquired from the dismembered Austro-Hungarian Empire. In the northeast the Bessarabian districts were annexed from Russia, and in

the south, between the lower Danube and the Black Sea, Dobrudja was taken from Bulgaria.

Dobrudja is for the most part steppe-land. The soil is very fertile, but owing to lack of sufficient water large tracts of it are not under cultivation. The province of Bessarabia extends from the Polish frontier in the north to the Black Sea in the south and is bound to the east by the Dniester and to the west by the Sereth River. The upper part of Bessarabia, south of the Polish frontier, is hilly and thickly wooded with beech, oak and birch. Lower Bessarabia widens into an open country of considerable fertility, but toward Galatz and Ismail, along the Black Sea littoral, it becomes marshy. At Galatz the Danube makes its sharp turn from north to southeast and not far away forms the great delta by which it reaches the Black Sea through its three mouths, the Kilia, the Sulina and the St. George. The Pruth, the largest river of Bessarabia, and the Sereth, both join the Danube in the environs of Galatz. West Bessarabia, at the foothills of the northern Carpathians, is the small province of Bukovina. It is much like northern Bessarabia in its physical features, being heavily timbered, hilly and very productive. Southwest of the Carpathians is the much larger province of Transylvania, a uniform plateau country of considerable fertility. And farther west bordering on Yugoslavia, is the Banat, famous as a wheat producing region.

The Carpathian Mountains curve like a sickle through the middle of Rumania and separate the country into two main geographical divisions, determining its climate and the course of its rivers. Northeast and southwest of the Carpathians are the new Rumanian provinces, that is, those acquired after the World War. South of this range of mountains is the old Rumanian kingdom. The Carpathians reach a height of 2,400 meters, but are for the most part gently rising wooded slopes and grassy hills and plateaus. Several cuts through them afford passage from north to south and from east to west, the most notable being the Szurduk, the Rothenturn and the Valcea passes. Nearly all are traversed by railways.

Aside of the Danube, which is considered an international river, the largest streams of Rumania are the Pruth and the Sereth in Bessarabia, the Maros of Transylvania and the Oltu or Aluta, the Ialomitza and Argesu of old Rumania. The tributaries of these various rivers are numerous and traverse the country in all directions. The Maros rises in the western Carpathians and flows first north and then west across the entire length of Transylvania, joining the Tisa west of Mako, where the frontiers of Rumania, Hungary and Yugoslavia come together. Nearly all other important rivers of the country, including the Oltu, which rises north of the lower Carpathians and cuts the Sibiu-Valcea pass in its southern current, are tributaries of the Danube, as is the Tisa itself, which in the end brings the waters of the Maros into the Danube. Of the Dniester River only the right bank belongs to Rumania. The Pruth and the Sereth, with

sources in the northern Carpathians, fed by many affluents, flow southward through Bessarabia like great arteries and join the Danube near Galatz. The Danube itself becomes a Rumanian river at Turtukai, since for hundreds of miles before this point, that is, from the time it reaches Rumanian soil at the Iron Gates, only its left bank is Rumanian. At Turtukai the river ceases to be a frontier and becomes entirely Rumanian, flowing first in a northeasterly direction between Dobrudja and Wallachia and then turning sharply northward to Galatz. At this point it forms a great bend and the mighty river proceeds on its last eastern stretch, forming the famous delta and its three mouths through which it empties into the Black Sea.

The climate of Rumania is as varied as the provinces which compose the kingdom. Old Rumania and Bessarabia experience hot, scorching summers. The weather in the Banat and Transylvania is less violent. The Danubian plain is whipped by winds in winter and baked by the sun in summer, the temperature ranging from 20° F. below zero in winter to 110° above zero in summer.

Population. With its new provinces Rumania acquired a conglomerate mass of peoples. The estimated population of the kingdom in 1930 was given as 18,326,000, but of this number only 12,000,000 or about 64% were Rumanians. The largest minority group are the Magyars in Transylvania. They number over 1,500,000 (18½%). In the uplands of the Carpathians, in the Banat region, there are 750,000 (13%) Germans; almost 1,000,000 (5%) Jews are scattered through all the provinces. The largest number of Jews dwell, however, in Transylvania, Bukovina and Bessarabia. In Dobrudja the Bulgarian element predominates, there being no fewer than 300,000 (1½%) Bulgarian nationals in that province. Turks, Tatars and Gypsies also dwell in the plains of Dobrudja. In the northern districts, along the Polish and Czechoslovakian frontiers and also in Bessarabia, the Slavic element, as Poles, Czechs, and Ukrainians, reaches less than a million (3.3%). The Rumanians are chiefly found in Wallachia and generally in the old Rumanian kingdom, but they are well distributed through all the territories. The population of the principal cities in 1930 was: Bucharest, the capital, 631,288; Chisinau, 117,016; Cernauti, 111,122; Ismail, 26,123; Jassy, 102,595; Galatz, 101,148; Timisoara, 91,866; Braila, 68,310; Oradea-Mare, 82,355; Arad, 77,225. See separate articles on these cities.

Religion and Education. All creeds enjoy the same rights in the Rumanian kingdom. The bulk of the population, about 12,268,081, professes the Eastern Orthodox faith, the national religion of Rumania. Until 1885 the acknowledged head of the national Rumanian church was the Greek patriarch of Constantinople. In 1885 the patriarch was forced to recognize the independence of the Rumanian church. Since then it has been governed by the Holy Synod of Bishops of Bucharest, presided over by the metropolitan of Bucharest, who is also the official primate

of Rumania. An unusual procedure is that Rumanian bishops are elected by the Chamber of Deputies, the Senate and the Holy Synod sitting in joint session; in addition, all ecclesiastic officials of the national Rumanian church are paid by the state. The monasteries of the Rumanian church not long ago owned nearly one third of the land, but reforms have gradually wrested the properties from them. For the most part the monasteries are now in remote and inaccessible mountain regions and a good many of them are in impoverished states. In the provinces acquired after the World War there are about 1,077,036 Roman Catholics, who have three bishops of their own. There is also an equal number of Protestants, with three bishops. Jews number close to 1,000,000.

In Rumania education is free and compulsory. In 1928 there were 14,123 elementary schools with a teaching staff of 35,000, enrolling over 1,500,000 pupils. Besides some 1,000 secondary schools and a score of higher educational institutions, there are four universities with a total enrollment in 1928 of 15,000 students. The universities are located at Bucharest, Jassy, Cluj and Cernauti.

Production and Industry. Like Yugoslavia and Bulgaria, its neighbors to the west and the south, Rumania is essentially an agricultural state, more than 80% of its population being engaged in the cultivation of the soil, in forestry, live-stock raising and in related pursuits. Wheat, barley, rye, oats and maize are the chief agricultural products. In 1928 Rumania produced 3,551,590 metric tons of wheat, and production of maize in the same year was 2,536,937 metric tons. In the following year the order was reversed. Wheat fell to 2,714,847 and maize rose to 6,100,000 metric tons. Even in pre-World War days, before Rumania annexed the rich grain districts in Dobrudja, the Banat and Bessarabia, it was one of the principal wheat exporting countries of Europe. The forests of the Carpathians are rich in timber, which constitutes one of the chief articles of Rumanian export. Flocks of sheep and goats and herds of cattle and horses pasture in the uplands of the Carpathians and through the extensive plains of Bessarabia. Again like Yugoslavia and Bulgaria, both noted for their livestock, Rumania is rich in domestic animals. In 1928 there were 12,941,051 sheep in the country. Horses numbered 2,000,000; cattle, 4,552,166; pigs, 3,075,782; goats, 418,616.

Mineral wealth is reported to be considerable, petroleum being the most important. Before the World War the old kingdom, less than one half its present size, held fourth place among the nations in the production of petroleum. The petroleum springs, both government and privately owned, are located at Prahova, Dambovitza, Bacan and Bazan. In 1928 the country produced 4,286,541 metric tons of crude oil. Other principal minerals are salt, coal, iron and copper ore, lead and antimony. Since 1863 salt mining has been a state monopoly. The salt mines are located along the lower Carpathians, embracing a stretch of about 250 sq. mi. In 1926 the salt production was

344,062 metric tons. The total coal output for the same year was given as 3,053,553 metric tons.

Of the Balkan countries Rumania has perhaps the best transportation facilities. The Danube is navigable from the moment it touches Rumanian soil, and the port of Constanza is one of the busiest on the Black Sea. The country is well provided with railways and motor roads. Trunk lines issue from Bucharest to north and south, connecting the capital with the Paris-Constantinople line at Belgrade and at Sofia. A main line running directly eastward from Bucharest reaches the Black Sea at Constanza. From the Polish frontier descends the Bessarabian railway, following the course of the Sereth. It joins the important Bucharest-Brasov railway, at Ploesti. Railways cross the Carpathians at several passes and connect the southern systems with those of Transylvania, the Banat, Bukovina and make contacts with the Hungarian, Czechoslovakian and Polish railways, thereby connecting with the main European systems. The regions formerly under Austro-Hungarian rule are those most amply provided with railway facilities. All the main lines are owned and operated by the state. In 1927 the total mileage of the Rumanian state railways was 8,744. In the same year the country had 54,648 mi. of roads, more than half of which were of macadam.

The chief Danubian ports of the country are Turnu-Severin, Kalafat, Giurgevo, Silistra, Braila and Galatz. The last town is the seat of the International Danube Commission, composed of representatives of various European nations. This commission has authority to regulate navigation on the Danube and to settle disputes. In 1928 the tonnage clearing from all Rumanian ports on the Danube was 825,524; from the port of Constanza on the Black Sea there cleared 1,113 vessels with a gross tonnage of 2,482,767. In conjunction with the state railways, the Rumanian government maintains regular commercial navigation service on both the Danube and the Black Sea. From April to October a daily airplane passenger service is conducted between Bucharest and Constantinople and Bucharest and Paris.

The foreign trade of Rumania is considerable and is mostly with France, Germany and Great Britain. Petroleum products, timber, cereals, and livestock constitute the chief exports. Wool, hides, wood articles, and fruit also are exported. In 1929 the total export values of Rumania were 28,951,393,000 *lei*, or about \$560,000,000. In the same year import values totaled 29,532,147,000 *lei*, or about \$580,000,000. The principal articles of import were textiles, machinery, chemicals, vehicles and leather goods.

Finance. The *leu* is the monetary unit of the Rumanian state. It is normally equivalent to a gold franc, or 20 cents, but for the last five years it has fluctuated in value from 160 to 300 *lei* for one American dollar. In 1929 the Rumanian government concluded a loan for \$101,000,000 in Paris, enabling it to pass a bill stabilizing the value of the *leu* at 813.6 to one English pound sterling. Like all the Balkan

and central European states, at the close of the World War, Rumania owed large sums of money to domestic and foreign creditors. In order to effect a balance in the budget the government has had to resort to severe economies. Meanwhile payments of the old debts were imperative, only made possible by allowing many of the railways to decay and making only the most urgent repairs to docks and other government properties. The budget and expenditures for 1930 were fixed at 37,450,000,000 *lei*. On Jan. 1, 1928 the country's internal debts amounted to 23,239,200,000 *lei*. The external debts in the same year were: \$66,060,560; 475,793,300 *lire*; 129,752,793 pounds sterling and 499,099,500 francs. In 1929 the external debts were increased by the conclusion of the \$100,000,000 loan at Paris.

Government. Rumania is a constitutional monarchy, governed by an hereditary king. In 1923 a new constitution was adopted establishing universal suffrage and introducing drastic agrarian reforms. According to the provisions of this constitution the forests and subsoil of the kingdom belong to the nation. Until recently the land of Rumania was owned by privileged *boyars* (landowners), but through a series of reforms the government has done away with this antiquated feudal system and the peasants are now owners of their farms.

The legislative branch of the Rumanian government is vested in two chambers, a Senate and a House of Deputies. The Senate consists of 170 members, distributed as follows: 82 from the old kingdom of Rumania, 45 from Transylvania, 24 from Bessarabia, 19 from Bukovina, four representing the universities, and 19 bishops. Besides these there are life members of the senate who acquire their membership through service to the state. Such are former prime ministers, commanders-in-chief of the armies and other high officials who have served the state for a period of four years or more. The Chamber of Deputies consists of 347 members, of which 168 are from the old kingdom, 112 from Transylvania, 51 from Bessarabia and 16 from Bukovina. The king has power to veto all laws passed by the Senate and the Chamber of Deputies. A council of ministers appointed by the king and responsible to him holds the executive power. Of the political parties the National Peasant Party founded in 1918 is the most influential. It came into power for the first time in 1927 under the leadership of the former prime minister, Julius Maniu.

For the purpose of local administration the kingdom is divided into 71 districts, which are in turn subdivided into communes, of which there are 8,854, both urban and rural. Juridically the same divisions prevail. There are communal and district courts. Besides the court of cassation in Bucharest, the highest court in the kingdom, there are 11 courts of appeal scattered through the various provinces.

RUMANIA, HISTORY OF. The Rumanian kingdom owes its origin to the union of the Danubian principalities of Walachia and Moldavia in 1859. The separate history of these provinces goes back to Ro-

man times and is much obscured, especially as to the origin of the people inhabiting them. The Emperor Trajan conquered the region and brought many Roman colonists into the land. Despite repeated conquests by barbaric tribes they somehow preserved the Latin tongue which is the basis of the Rumanian language of to-day. From the breakdown of the Roman Empire to the 10th century, Rumania was invaded by one group of barbarians after another in their drive forward into southern or central Europe. As a result of these invasions there were left behind by the 13th century, besides the descendants of the Romano-Vlachs, Slavs and Tatars.

Moldavia and Walachia. Two separate principalities, Moldavia and Walachia, were set up and as the Turkish power in Europe spread, they were obliged to accept the sovereignty of the Sultan. The two principalities began a united history toward the latter half of the 18th century, when through the rise of a spirit of nationality and the fact that the Turkish system of administration was the same for both they gradually drew together. From 1775 the principalities were the cause of numerous diplomatic and military conflicts between Russia and Turkey. Russia had succeeded, after occupying both provinces and holding them for brief periods, in wresting from Turkey important liberties and privileges for the inhabitants. Nevertheless the principalities remained under the Turkish rule, though under a sort of Russian protectorate until 1806 when, dissatisfied with the way Turkey carried out the stipulations regarding administration, Russia reoccupied them with ambitions, this time, to incorporate them in the Tsar's empire. In 1812, however, the Tsar restored Moldavia and Walachia to Turkey, retaining only Bessarabia.

Independent Kingdom. After the Greek War of Independence, in 1829, by the Treaty of Adrianople, Russia assumed official protectorate over both principalities. But by this time, Vlach nationalism had advanced to a point where the assemblies of both principalities voted for the establishment of a united and independent kingdom to be known as Rumania. In 1856 the Congress of Paris met after the defeat of Russia in the Crimean War and sanctioned the proposal, provided the two principalities maintained separate legislative assemblies and each was ruled by its own hereditary prince. These conditions were accepted; but in 1859 the legislative assemblies of the two autonomous principalities, one sitting at Bucharest and the other at Jassy, got around the obstacle to their union by electing the same prince Alexander Cuza as ruler of both. In this manner they were practically united under the name of Rumania. The Powers reconvened in Paris to consider the situation. After protracted deliberations the Paris Conference found it expedient to approve the union and the single ruler. Bucharest now became the nation's capital, and one ministry and a united legislative body began to function in 1862. Two years later a senate was created. Prince Cuza's rule was short

lived. He attempted radical agrarian reforms which brought him the ill will of the land-owning nobles, and was deposed in 1866. Despite the admonitions of the Powers that they choose a hereditary prince for their new ruler, the Rumanians elected Prince Charles of Hohenzollern-Sigmaringen.

The new state did not, however, become completely independent from Turkey until after the Russo-Turkish war of 1877-78 which was fought primarily for the liberation of Bulgaria. During this war the Rumanian Government first allowed the armies of Russia to pass through Rumanian territory and then, in Apr. 1877, officially declared war on Turkey. Rumanian soldiers aided the Russian forces in the BATTLE OF PLEVNA. A peace treaty was signed between Turkey and Russia at San Stefano, near Constantinople; but the Powers were dissatisfied with the dispositions, and the CONGRESS OF BERLIN was called in 1878 to revise the San Stefano Treaty. The Berlin Treaty recognized the complete independence of Rumania from the sultan and ceded to Rumania northern Dobrudja. Russia, however, much to Rumania's displeasure, gained parts of Bessarabia which she had previously yielded to Rumania. In 1881 the Rumanian principality was elevated to a kingdom and Prince Charles proclaimed King Charles I of Rumania.

Internal Strife. Meantime the Government struggled with the internal political and economic conditions. The peasants had been emancipated in 1864, and the Government was continuing the distribution of the state lands among the peasantry. But conditions were far from satisfactory. There was dissatisfaction especially among the Jewish element, which almost precipitated a revolution. According to the Constitution, Jews were not eligible to citizenship; since only citizens could own land this meant that the Jewish people were barred from ownership of farms. The Treaty of Berlin in 1878 had recognized Rumania's independence on condition that all persons in Rumania be accorded absolute religious freedom without infringement of their political rights. This provision was specifically directed to help the Jews, and it aroused keen resentment among the Rumanians. No administration could comply with the provisions of the Berlin document and at the same time retain the confidence of the people, who were against granting the Jews the privilege of owning land. The problem was at last solved by the convocation of a constituent assembly which amended the Constitution to make it possible to enjoy rights of citizenship and of land ownership.

But though the peasants were liberated in 1864 their condition was deplorable. They were being exploited by the land-owners and the Jewish money-lenders. Indignation ran high, and in 1907 a serious uprising by the peasants took place, resulting in the partial destruction of many villages and towns before the revolt was quelled.

Foreign Problems. The foreign problems were no less complicated than the domestic ones. There were millions of Rumanians under foreign rules, in

Hungary, in Russia, and under Turkey. The policy of the Government was to preserve the identity of these unredeemed nationals and one day to unite them in a single great state. This policy clashed with the interests of Austro-Hungary, and relations between the two countries became strained time and again.

While Rumania was occupied with her foreign and domestic problems, her neighbors, Bulgaria, Serbia and Greece, formed an alliance and in Oct. 1912 declared war on Turkey. (See BALKAN WARS.) Rumania remained neutral; but the success of the Balkan allies and the consequent dismemberment of Macedonia and Thrace nevertheless brought Rumania into the picture. She had nationals in Macedonia, Thrace and the Epirus who now found themselves under the jurisdictions of one or other of the three victorious countries. Taking advantage of this, Rumania sought a recompense by demanding revision of her frontiers in Dobrudja. Failing to obtain satisfaction from Bulgaria, she joined Serbia and Greece in the second Balkan War. A Rumanian army of half a million invaded Bulgarian Dobrudja and marched toward Sofia, the Bulgarian capital. In the meantime Serbia, Greece and Turkey had also declared themselves against Bulgaria. Bulgaria was quickly made powerless, and on Aug. 10, 1913 a treaty was signed at Bucharest by which Rumania received the districts in Dobrudja she demanded. Bulgaria regarded Rumania's attack at a time when her armies were engaged in battle with the Serbians and the Greeks as the height of treachery and relations between the two neighboring states have ever since been very hostile.

World War. On the eve of the World War the chief domestic problem in Rumania still arose out of the land system, the large land-owners holding most of the land and refusing to segregate or sell any. The peasants were dissatisfied, and further agrarian reforms were badly needed. The advent of the war temporarily shelved this question. The issue of the day became whether Rumania should remain neutral or whether she should join the war, and if so, on what side. Ian Bratianu, the premier, who was making efforts to expropriate the land from the large land-owners, now turned his attention to the war problem and entered into negotiations with the Central Powers. But Take Ionescu, heading the Conservatives and other opposition elements, advocated immediate alignment of Rumania on the side of the Allied Powers. On Aug. 17, 1916, after having been guaranteed Bukovina, the Banat, Transylvania and other territories inhabited largely by Rumanians, Rumania declared war on the Central Powers. At first the Rumanian armies invaded Transylvania, but they were soon repelled and by December the Germans and Bulgarians had conquered most of the country. The Germans took Bucharest on Dec. 6 while the seat of the Rumanian Government was transferred to Jassy, in Bessarabia. It was here in 1917 that the Rumanian legislature finally passed the law expropriating the land of the large estate-owners.

By the spring of 1918 Rumania had completely capitulated and sought peace with the Central Powers. On May 7, 1918 a treaty was signed at Bucharest by which Rumania was reduced to virtual economic slavery. The defeat of the Central Powers in the fall, however, set the arrangement aside. The Cabinet which had accepted the terms of the Central Powers was overthrown, and a new ministry headed by Bratianu was formed on Dec. 14, 1918. By the Peace Treaties in Paris Rumania received practically everything that the Allied Powers had promised her before she joined the war, Transylvania, Bukowina, part of the Banat of Temesvar and Bessarabia, adding 7,500,000 people to the former population.

On Oct. 15, 1922 at Alba Iulia, King Ferdinand I and Queen Marie were crowned sovereigns of Greater Rumania. In 1925 Crown Prince Carol, owing to difficulties caused by his love affairs, fled the country and renounced his right to the throne. His minor son, Prince Michael, was proclaimed heir and a council of regents created. Upon the death of King Ferdinand, July 21, 1927, Prince Michael ascended the Rumanian throne. Three years later on June 6, 1930, as a result of a series of political intrigues, the overthrow of Bratianu and the advent to power of the Peasants' Party led by Maniu and Jorga, Carol, who since 1925 had lived in exile, landed in Bucharest in an airplane and was acclaimed by the people as the new King of Rumania. The Rumanian Parliament held an extraordinary session at which it repealed the law of Jan. 4, 1926 which had excluded Carol from succession to the throne.

BIBLIOGRAPHY.—William Miller, *The Balkans, Roumania, Bulgaria, Serbia and Montenegro*, 3rd rev. ed., 1923; Robert W. Seton Watson, *Rise of Nationality in the Balkans*, 1917 (Bibliography); Nicolae Jorga, *Histoire des états balkaniques jusqu'à 1924*, 1925; Jean N. Dudesco, *L'évolution économique contemporaine des pays balkaniques, Roumanie, Bulgarie, et Serbie*, 1915.

RUMANIAN, a ROMANCE language spoken by 15,000,000 people isolated for 15 centuries among Slavic-speaking populations, whence the large number of SLAVIC words in its vocabulary. It is characterized by extensive diphthongization (e.g., Latin *cresta* = Rumanian *creasta*, "crest"), survival of post-tonic vowels (e.g., Latin *juniperus* = Rumanian *jneapau*, "juniper"), change of *ct* to *pt* (e.g., Latin *factum* = Rumanian *fapt*, "deed"), and frequent change of *l* to *r* (e.g., Latin *dolet* = Rumanian *dore*, "he is afflicted"). The language has preserved a declension both with and without the article, the latter being suffixed to the noun, as *lup*, "a wolf," but *lupul*, "the wolf." The future is formed from Latin *volere*, "will," (cf. English "I will (to) do"), and the passive is replaced by the reflexive, as *să vede*, "he is seen," literally, "he sees himself."

H. F. M.

BIBLIOGRAPHY.—O. Densusianu, *Histoire de la langue roumaine*, 1901; H. Tiktun, *Rumanisches Elementarbuch*, 1905.

RUMELIA, EASTERN, a province of southern Bulgaria, traversed by the Maritza River, on whose banks is the city of Philippopolis (Plovdiv), the second largest city of BULGARIA.

History. Upon the creation of Bulgaria into a modern principality after the Russo-Turkish War in 1878, Eastern Rumelia was declared an autonomous province under Turkish suzerainty. Philippopolis was chosen as the capital and a Christian was appointed governor. Seven years later, in 1885, the province proclaimed its union with Bulgaria. Turkey massed its troops at the frontier and was ready to attack, but seeing that European sentiment favored the union, refrained. Serbia, however, fearing that the enlargement of Bulgaria disturbed the balance of power in the Balkans, declared war on Bulgaria on Nov. 14, 1888. She was beaten severely by the Bulgarians, and the union of Eastern Rumelia with Bulgaria was confirmed by a peace treaty signed in Bucharest, Mar. 3, 1886.

RUMFORD, BENJAMIN THOMPSON, COUNT (1753-1814), British scientist, born at Woburn, Mass., Mar. 26, 1753. He early showed great natural aptitude for science and mathematics, and his marriage, in 1772, to a wealthy widow opened up opportunities for the development of these talents. He became a protégé of the royal governor of New Hampshire, who sent him to England. Here he rose rapidly in Lord North's government while conducting scientific investigations into gunnery problems. In 1783, he resigned from the British service and, by chance, became acquainted with the elector of Bavaria, at whose invitation he remained at Munich for 11 years as minister of war and police and as grand chamberlain. At Munich he conducted his most famous experiments, proving that heat was not a fluid as then believed. He reorganized the Bavarian army, police system and public charities and was made a count, choosing his title from Rumford, now Concord, N.H. He returned to England in 1795 where he founded the Royal Institution and the Rumford medal of the Royal Society. The Rumford professorship at Harvard and the Rumford medal of the American Academy of Arts and Sciences were his foundations. After 1804 he lived in Paris, France, and died at Auteuil, Aug. 21, 1814.

RUMFORD, a village in Oxford Co., southwestern Maine, situated on the Androscoggin River, 60 mi. northwest of Portland. It is served by the Maine Central Railroad. The falls of the river generate hydroelectric power for large paper mills. The village of Rumford was founded in 1893. It is essentially an industrial community about one-fourth of which is foreign born. Pop. 1920, 7,016; 1930, 8,726.

RUMINANTS, mammals that chew the cud. They form a group (*Pecora*) in the order of even-toed quadrupeds (*Artiodactyla*), and embrace the oxen, sheep, goats, antelopes, deer, giraffes, chevrotains, camels and llamas. They agree in a special form of dentition, one feature of which is the absence of front teeth in the upper jaw. The ruminants are so called in reference to the fact that they ruminate; that is, after their vegetable food has been hastily swallowed, it is forced back up the gullet, from the foremost compartment of the four-chambered stom-

ach, in portions called cuds. It is then thoroughly masticated and re-swallowed, this time passing into the digestive part of the complicated stomach. All ruminants have the third and fourth of the instep-bones of the feet lengthened and united into a cannon-bone, and the toes shod with hoofs. The heads of the males are usually provided with paired horns.

E. I.

RUMP PARLIAMENT, the remnant of the Long Parliament left after PRIDE'S PURGE in 1648. It continued, though only nominally, as the government of England under Cromwell; but the actual government was the army and an irresponsible Council of State sufficiently large to command a majority of the House. Cromwell suppressed it by means of his troops in 1653.

RUNEBERG, JOHANN LUDVIG (1804-77), Swedish poet, was born at Jacobstad, Finland, Feb. 5, 1804. Finland was then a Swedish possession, and Runeberg's writings were in Swedish, although he wrote chiefly on subjects connected with the history of Finland. He was educated at the University of Abo, which was later transferred to Helsingfors. Runeberg founded the newspaper *Helsingfors Morgonblad* and edited it for a number of years. His fame as a poet rests chiefly on the cycle of narrative poems whose collective title is *Ensign Stal's Songs*. These poems deal with the war of 1808-09, as a result of which Sweden lost Finland. Other notable poems of Runeberg's are *The Elk-Hunters*, *Christmas Eve* and *Hanna*. He died at Borga, Finland, May 6, 1877.

RUNES (Old Icelandic *rúnar* "mysteries, hidden lore"), the oldest extant Germanic writing, used by all Germanic tribes and apparently derived from signs selected from the Greek and Latin alphabets in the region of the Black Sea in the 2nd century A.D. Transmitted from here to the Baltic regions, they were taken over by the Scandinavians as well as by the continental German tribes and were brought to England by the Angles and Saxons. The runic signs were used chiefly for inscriptions on tombstones, houses, tools, weapons and articles of jewelry; only rarely and at rather late periods are they to be found in books in the northern countries. The earliest finds are of such a remote age that their appurtenance to be three main divisions of GERMANIC dialects cannot definitely be determined. Most of the finds, over a thousand, belong to the Viking period and Sweden. The common Germanic runic alphabet, called Futhork after the first six letters, consists of 24 signs, arranged in four rows of six signs each; it was amplified among the Anglo-Saxons, but was reduced to two rows of eight signs each in the later Norse runic alphabet. Its angular forms and the absence of horizontal lines and curves are due to its almost exclusively epigraphic use.

E. Ro.

BIBLIOGRAPHY.—E. Sievers, "Runen und Runeninschriften," in H. Paul, *Grundriss der germanischen Philologie*, 2nd ed., 1896; T. von Friesen, *Om runskriftens namkomst*, 1904; A. Jöhanncsson, *Grammatik der urnordischen Runeninschriften*, 1923.

RUNNING, the sport of swift travel on the feet over a measured course. It was one of the earliest sports of civilized man, and was held in great popularity by the Greeks in their Olympic games. Such contests were trials of endurance, and the winners were lavishly rewarded. The **MARATHON**, also of Greek origin, has been revived in modern times, and is now regularized in all countries over a distance of 26 miles, 385 yards. **DISTANCE-RUNNING**, in which class the Marathon belongs, includes all races from 3 miles up. Such races are popular chiefly in England, France and the Scandinavian nations. In the United States running has been mainly restricted to track lengths, i.e., sprints of 100, 200, 220, 300, 440 and 880 yards, and races of 1 and 2 miles. In the present century the world's record for 100 yards was $9\frac{3}{8}$ sec., established successively in 1906, 1914, 1921 and 1922, until in 1929 Edward Tolan, an American, established a mark of 9.5 sec. In 1932 Ralph Metcalfe, an American, also ran the distance in 9.5 sec. World records in the longer distances, from 660 yards to 25 miles, are held by British, French, Swedish and Finnish.

RUNNYMEDE, a small island in the Thames, near Windsor, where **MAGNA CARTA** was signed. Runnymede has been acquired for the public.

RUN-OFF from any area is that portion of the rainfall that finds its way into the streams which drain the **WATERSHED**. Some of the main factors governing run-off are temperature, rainfall, season, extent of vegetation, geological formation, topography and surface storage. These are only a few of the numerous causes that produce irregularity in run-off and make it impossible to formulate any simple method for computing the run-off in terms of percentage of rainfall. Records of stream flow from the watershed covering a period of years taken in conjunction with the annual rainfall during that period, if properly studied, will lead to useful results upon which may be predicated a figure for run-off that can be relied upon. E. E. W.

RUPEE, the British Indian monetary unit, a silver coin equivalent to about 36.5 cents at par; also an East Indian silver coin.

RUPERT, ST. (8th century), bishop of Worms under Childebert III, was born in France, became a preacher in Bavaria, Styria and elsewhere in Germany, and is known as the "Apostle of the Bavarians." After establishing many churches and monasteries, under the patronage of Duke Theodo II of Bavaria, he finally died at what is now Salzburg, then called Juvavum. Here he died on Mar. 27, 718, famous for his achievements in consolidating the power of the Church in Germany. His feast day is Mar. 27.

RUPERT, KNIGHT, a legendary personage closely resembling St. Nicholas, formerly very popular in the small towns of northern Germany. He is supposed to keep watch throughout the year over naughty children, and to appear at Christmas time dressed in a white robe, an enormous wig and a mask,

to distribute gifts to the deserving. In certain parts of Germany he also appears as a horseman in the May Pageant.

RURAL ELECTRIFICATION. The number of farms in the United States being supplied with electricity from central stations has increased at the rate of 100% every $3\frac{1}{2}$ years since 1923. During the calendar year 1930, 90,000 additional farms were electrified, an increase of 16.3% over 1929. On January 1, 1931, more than 10% of the farms were using central station service. Among the various states, California ranked first with 81,250 farms (about 60%) connected to central station lines. New York was second with 61,086 and was followed by Ohio, Washington, Pennsylvania and Wisconsin respectively. In addition to farms using central station service, it is estimated that about 200,000 are equipped with individual lighting plants. In 1929 25,000 plants of this type were sold.

Farm electrification has been stimulated by the co-operative effort of farmers, farm organizations and agricultural colleges, by electrical equipment manufacturers and utility companies in the promotion of research by the establishment of experimental lines and farms and by a general study of the problems of farm electrification. Committees on "the relation of electricity to agriculture" have been established in 24 states. More than 200 publications on farm uses of electricity have been issued. A survey of research agencies has disclosed over 700 separate investigations having some bearing on the use of electricity in agriculture.

Rural home uses of electricity are similar to those of urban homes, with the addition of such operations as separating cream and churning butter and with a greater use of power in the preparation of food and in washing and ironing clothes. There is also an increasing use of electricity for cooking, water heating, dish washing and cleaning. Industrial applications of electricity on the farm include: pumping water for irrigation and domestic water systems, milking, clipping livestock, refrigerating milk and other perishables, sterilizing milk utensils, grinding and mixing feeds, filling silos, threshing, hoisting hay, sawing wood, hatching and brooding chicks and illumination, both for stimulating egg production and for lighting yards and buildings. Other uses which are becoming practical include: the heating of hotbeds, cold storage of perishables, the operating of hay driers, and the control of insects by means of electric lights and traps.

Rates for electricity are gradually lowering as its use increases. The serving of small hamlets and rural garages, grist mills, cotton gins and other industries, and the interconnection of power systems are speeding the construction of rural lines.

European farmers use electricity extensively. It is estimated that more than 50% of the farms of Denmark were using electric power in 1925. Australia and New Zealand offer electricity as one of the advantages of farming in those countries. Foreign farm uses are similar to those of the United States, with

the possible exception of a wider application of small motor power, a greater use of electricity for threshing and an apparently successful use of a few large electric plowing outfits in France and Italy. G. W. K.

RURAL LIFE, RECENT CHANGES IN. Two significant changes in rural life are in evidence to-day when reviewed from the standpoint of social organization and institutions. The first is that the farmer and his family now have the advantage of channels of communication and transportation. The automobile and the truck have cut down by four or five times the distances between various centers. Moreover, the radio, the daily newspaper, the parcel post and the telephone are appearing in increasingly greater numbers in the farm home.

There are those who would call this change urbanization, in the sense that the urban is reaching out to dominate and control the rural. The analysis is rather that the rural is now exposed on grander scale and on more equal terms to those great parent causes which have exerted their influence upon the urban, with greater facility through the years.

Much has been done as measured by the changes in institutional and group arrangements in rural society. Consider the district school and the country church. They were built to accommodate small groups of people bound together by tradition, language or ancestry, and separated by distances a horse could travel over poor roads. With the reduction of distances in terms of time with the greatly increased costs and with the decreasing numbers of people in the country, has come the movement for the expansion of rural life institutions. From 1918 to 1928, according to the U.S. Bureau of Education, one-room district schools have decreased 22% while consolidated units increased over 200%. The South leads in reduction of the one-room units and the West in construction of the larger consolidated units. The number of pupils transported increased over 350%. It is reported that 88% of the transportation done in 1928 was by motor vehicles. The consolidated units are most frequently found in the villages and town centers.

The case of the country church is not quite so definitely recorded. Its movement, however, is strikingly parallel to that of the school. The country church has been the small church—115 members on the average in 1926 compared with 546 members in the city. It spends only \$1,400 per church compared with \$10,000 for the city church. Nevertheless, its adult members contribute \$13 per capita as compared with \$21 for the city members. Consolidation, federation and organic union of whole denominational bodies is the new order of the day.

A parallel story to that of the farmer could be told for the villager and his family. He is patronizing more frequently the service institutions in the larger centers beyond his own. His own institutions in turn are readjusting to the changing habits of their clientele.

A second change or movement can be stated in terms seemingly contradictory or at least paradoxical

to the first, namely, that the farmer and his family are staying at home, building and developing institutions and group relations which are indigenous to rural life. Farmers may be identified more fully with the life of the village and town centers, and still be busy and active within their own circles. This local life and activity is no longer on the old neighborhood or settlement basis, however, where there was a general sharing of common interests with a minimum of organization and where residence in the same locality by its own token meant neighborliness.

In 1915 there were 5,400 marketing and purchasing organizations among farmers; in 1925, 10,800, and in 1930, 12,000. Membership growth was from 650,000 to 3,100,000. The volume of business transacted amounted from \$636,000,000 to \$2,500,000,000. Federal appropriations combined with the state and county funds have made possible a great increase in the number of educational agents or advisers working with local farmers, both individually and in organized groups. The percentage of counties with white men county agents increased from 37 in 1915 to 77 in 1930. This service extends to women as well. In 1915 11% of the counties had white women home agents; in 1930 this had increased to 43%.

Young people are not overlooked. There were 756,000 boys and girls in 52,000 organized groups known as 4-H Clubs, in 1929. This represented a gain of 27% in membership and 20% in clubs over 1925.

Despite the readjustments which have centered rural life in villages and towns, rural people have continued in their support of educational and religious institutions. The consolidated school plan frequently calls for local units for the smaller children under what is known as the 6-33 plan. The larger parish plan frequently retains local units for religious education or women's group activities in the country. Local parent-teacher associations have grown apace and religious or social groups and associations fill the countryside until some of the people themselves say that the rural areas are over-organized.

Finally, rural people are demonstrating a new enthusiasm for some of the cultural arts, especially drama and music. During 1930, in one of the mid-western states, 3,000 rural people actually took part in plays. This represented the work of about 350 local groups in 20 counties. In the same year about 5,000 people organized themselves into local groups of various sizes and characteristics for choral music. A parallel statement could be drawn for the villager and his local organizations and institutions. J. H. K.

RUSCHUK (Bulgarian *Russé*), capital of the Bulgarian district of Ruschuk and chief port, situated at the confluence of the Danube and Lom rivers. It is connected by rail with Sofia, Varna and Bucharest, a ferry transporting the passengers across the Danube to the Rumanian station. Ruschuk is an important industrial center, having cigarette factories, soap works, breweries, aerated water factories, dye works and tanneries. Bricks, tiles and potteries are also manufactured in large quantities. Ruschuk is the

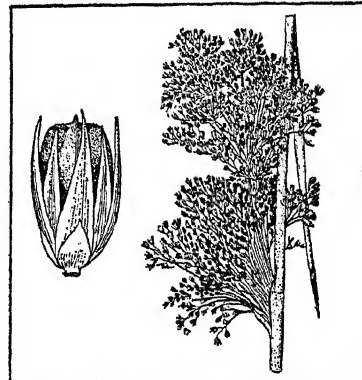
seat of an Orthodox metropolitan and a Catholic bishop. In Roman times the city was a Danubian fort. During the Russo-Turkish wars it was often threatened with destruction. In 1877 it was wrested from the Turks by the Russians and made part of the Bulgarian principality. But it still has many Turkish inhabitants and is distinctly Turkish in appearance, with its mosques, bazaars and baths. Pop. 1931, 46,148.

RUSH, BENJAMIN (1745-1813), American physician, was born in Byberry township, near Philadelphia. He graduated in 1760 from Princeton and received his M.D. at Edinburgh in 1768, and thereafter spent a year in the hospitals of London and Paris. Rush was founder of the first anti-slavery society in America; in 1776, he signed the Declaration of Independence as a member of Congress for the state of Pennsylvania. He was considered the ablest clinician of his time. He described cholera infantum in 1773; was the first, after Bylon of Java, to describe dengue, and one of the first to note that fever was occasioned by drinking cold water when overheated. Rush's monograph on insanity was pronounced by authorities to be the only systematic American contribution on the subject prior to 1883. He also wrote a vivid account of the yellow fever epidemic in Philadelphia in 1793. Rush's writings include other topics in addition to this clinical memoirs, such as hygiene of troops (1777), diseases of North American Indians (1774) and their vices (1798), and his account of the German inhabitants of Pennsylvania (1798). He died in Philadelphia on April 19, 1813, after a five days' illness from typhus fever. M. F.

RUSH, RICHARD (1780-1859), American diplomat, second son of Dr. BENJAMIN RUSH, was born in Philadelphia, Pa., Aug. 29, 1780, and educated at Princeton. He began practicing law in 1800, and in 1814 became Attorney General of the United States. Three years later he was sent as Minister to England where he completed many important treaties, including that fixing the northern border at the 49th parallel and arranging for 10 years joint occupation of Oregon with Great Britain. He returned to the United States in 1825 and was appointed Secretary of the Treasury. Appointed by President Polk, he served as Minister to France in 1847-51, being the first foreign representative to recognize the Second Republic in 1848. His publications include *Narrative of a Residence at the Court of London*, and *Washington in Domestic Life*. He died in Philadelphia, Pa., July 3, 1859.

RUSH, a name applied to various aquatic or marsh plants of the rush and sedge families. The true rushes form a large genus (*Juncus*) of grasslike plants with very small, greenish, six-parted flowers, closely allied to the lilies. The common rush (*J. effusus*), abundant in wet places in most temperate regions, grows in clumps with soft, cordlike, erect stems, 2 to 4 ft. high, and greenish-brown flowers in a dense cluster. The soft pith of the stem of this and several other species is used to make candle wicks, and the stems

themselves are woven into mats, chair seats and other articles. Among the plants of the sedge family most commonly called rush are the great bulrush or mat-rush (*Scirpus validus*) and the chair maker's rush (*S. americanus*). See also BULRUSH.



FROM JEPSON, MAN. FL. PLANTS CALIF., COPYRIGHT

COMMON RUSH

Single flower and seed capsule (enlarged)
and flower cluster

RUSH-BAGOT CONVENTION, 1817, an exchange of notes between Richard Rush, acting Secretary of State, and Sir Charles Bagot, British Minister Plenipotentiary to the United States, for the maintenance, by both Great Britain and the United States, of small and equally armed naval forces for the policing of the Great Lakes. The agreement, which meant disarmament on the Great Lakes, with minor adjustments, has lasted to the present.

RUSHVILLE, a city in southeastern Indiana, the county seat of Rush Co., situated on Flat Rock Creek. It is a railroad center served by five lines and a shipping point for grain, hogs and other livestock, raised in the vicinity. The local industries include lumber and flour milling and the manufacture of machinery. Rushville was chartered as a city in 1883. Pop. 1920, 5,498; 1930, 5,709.

RUSKIN, JOHN (1819-1900), English writer, was born in London, Feb. 8, 1819, of well-to-do Scotch parents. After some irregular early schooling and extensive travels on the Continent, he was graduated at Oxford in 1842. At 14 he had been given a copy of Roger's *Italy* illustrated by J. M. W. TURNER. His first book on art, written at 24, was a defense of Turner's painting; published in 1843, it was the first volume of the noted *Modern Painters*. About 1845 the young author traveled by way of Switzerland to Italy, and there began his long study of the Italian masters. His chief favorites were GIOTTO, FRA ANGELICO, BELLINI and GHIRLANDAIO. Virtually saturated with Italian moral and religious art, he attempted to reconcile Turner's painting with that of Fra Angelico, on the ground that both artists were truthful; Italian painting was indeed truthful, and with characteristic enthusiasm and impetuosity Ruskin endeavored to turn the 19th century backward to that truth. At this time people in England were not generally well-

informed about art, and the critics' audience was large, eager and often violently in disagreement with his pronouncements. The next four volumes of *Modern Painters* appeared between 1846 and 1860. In 1848 Ruskin married Euphemia Chalmers Gray, but the unhappy marriage was annulled six years later.

Interested in architecture as well as in painting, in 1849 Ruskin published *The Seven Lamps of Architecture*, with etchings by himself. This field was further worked in *The Stones of Venice*, 1851-53. These three works make up the main body of Ruskin's art criticism; his minor works on the subject include *Pie-Raphaelism*, 1851, *Elements of Drawing*, 1857, *Political Economy of Art*, 1857, and *The Elements of Perspective*, 1859. After 1860 Ruskin devoted himself for a time to moral and social problems. With the sincerity of a Tolstoy, he strove to better conditions for the workingman. He established a workers' guild, a workers' museum, and he gave away a fortune of approximately \$1,000,000. His books of this period include *Unto this Last*, 1860, *Munera Pulveris*, 1862-63, *Crown of Wild Olive*, 1866, *Time and Tide*, 1867, and *Flois Clavigera*, 1871-84. The latter part of Ruskin's career is marked by his professorship of art at Oxford from 1870-84, and his retirement in 1884 to "Brantwood," at Coniston, in the Lake District. His writings of this last period include *Aratra Penetelici*, 1872, *Love's Meime*, 1873, *Ariadne Florentina*, 1873, *Val d'Arno*, 1874, *Mornings in Florence*, 1875-77, *Proserpina*, 1875-86, *Deucalion*, 1875-83, *St. Mark's Rest*, 1877-84, *The Bible of Amiens*, 1880-85, *The Art of England*, 1883, and the autobiographical *Praeterita*, written in 1884-89. Ruskin died at Coniston, Jan. 20, 1900, and was buried in accordance with his wish in the local churchyard.

As an art critic Ruskin was too often erratic, partisan and unpractical. He was virtually alone in the field, and his judgments were at times inevitably mistaken. The important fact was that he made people think seriously about art; his pronouncements were so vehement that indifference to what he said was impossible. As a prose writer he was unconventional, fiery, brilliant, headlong and stimulating. Perhaps he will be longest remembered, in the end, for some of his beautiful passages on nature.

BIBLIOGRAPHY.—W. G. Collinwood, *Life of John Ruskin*, 2nd ed. 1900; Frederic Harrison, *John Ruskin*, 1902; F. W. Roe, *The Social Philosophy of Carlyle and Ruskin*, 1921.

RUSKIN COLLEGE, the first residential college for workingmen. The college was founded at Oxford, England, in 1899 by two Americans, Mr. and Mrs. Walter Vrooman, with the support of Dr. Charles A. Beard, and of a number of well known members of the British Trade Union Movement and of the University of Oxford. Until 1910 the college was governed by a Council of Trade Union Leaders and of members of Oxford University. Since 1910 the government of the college has been entirely in the hands of workers' organizations. During the World War the college was used as a home for nurses; but the correspondence department was maintained. The policy is to give

both men and women knowledge, and to encourage them to think out a philosophy for themselves.

G. M. J.

BIBLIOGRAPHY.—A. Mansbridge, *An Adventure in Working Class Education*, 1920, K. Hutchinson, *British Labor's University*, Sursey, Dec. 15, 1926.

RUSSELL, BERTRAND ARTHUR WILLIAM (1872-), 3rd Earl Russell, English philosopher and mathematician, was born at Trilbeck, May 18, 1872. He was left an orphan at an early age, and educated by private tutors. In 1890 he entered Trinity College, Cambridge, where he later held a fellowship until deprived of it on account of his attitude toward the World War. At the outbreak of the war he was active in appealing to the intellectuals of Europe, for which he was prosecuted. Russell was a candidate for Parliament on the Labor ticket in 1922 and 1923. Not satisfied with traditional education, he and his wife organized a school of their own in 1927. Russell has made several lecture tours in the United States and has frequently appeared in debates on public questions. In 1931, on the death of his brother, he succeeded to the title Earl of Russell.

Among his works the following titles are important: *Principles of Mathematics*, 1903; *Principia Mathematica* (with A. N. Whitehead), 1910-13; *Introduction to Mathematical Philosophy*, 1919; *Outline of Philosophy*, 1928; *Scientific Method in Philosophy*, 1914; *Principles of Social Reconstruction*, 1917; *Mysticism and Logic*, 1918; *On Education*, 1926; *The Prospects of Industrial Civilization*, 1923; *Analysis of Mind*, 1921; *The Scientific Outlook*, 1931.

Russell has called himself a logical atomist. This position is akin to realism, and Russell is usually classified among the English realists. Logical atomism is based on symbolic logic, and Russell has been a leading figure in developing this mathematical logic. Early in his career he became interested in Peano, and one of his chief contributions to philosophy is that of bringing philosophy and mathematics together. His early attitude on metaphysics is represented by his essay entitled *A Free Man's Worship*. Here Russell seems to be content to live the life of reason and dwell in a world constructed by his own imagination. But the war made a radical change in his thinking. Since that catastrophic event no philosopher was more active in trying to reform the affairs of the world than Russell. The result has been a more pragmatic leaning in his philosophy.

RUSSELL, GEORGE WILLIAM (1867-), Irish poet known as Æ, was born at Lurgan, County Armagh, Apr. 10, 1867. He was educated in the Rathmines School, Dublin, and then entered an accountant's office. In 1897 he joined the Irish Agricultural Organization Society and became an enthusiastic supporter of its aims to benefit Ireland and raise the level of Irish living. From 1904-23 he was editor of *The Irish Homestead*, and from 1923 was editor of *The Irish Statesman*. Russell has been an important figure in the Irish literary revival, and his poems are among the finest products of that move-

ment. They include *Homeward: Songs by the Way*, *The Earth Breath*, *By Still Waters* and *Voices of the Stones*. He has written also *Dendre*, a three-act drama, several volumes of essays, and tales and essays.

RUSSELL, HENRY NORRIS (1877-), American astronomer, was born at Oyster Bay, N.Y., Oct. 25, 1877. He studied at Princeton University where he took his Ph.D. in 1900, and afterwards went to King's College, Cambridge, as a research student. He joined the faculty at Princeton in 1905, became professor in 1911, and director of the observatory in 1912. In 1921 he was appointed research associate of the Mt. Wilson Observatory. During his early years at Cambridge he made extensive determinations of stellar Parallaxes, but is chiefly known for his researches on the masses and luminosities of the stars, and his theories of stellar evolution as well as his spectroscopic investigations following the new developments in physics.

RUSSELL, IRWIN (1853-79), American poet, was born at Port Gibson, Miss., June 3, 1853, and graduated at the University of St. Louis in 1869. He was admitted to the bar in 1872, but 4 years later abandoned his law practice to devote himself to writing. He settled in New York City and became known for his graceful verse. He is best known for his verses delineating Negro character and written in Negro dialect. Many of his poems were published in *Century Magazine*. Russell died en route to California, Dec. 23, 1879. His poems were posthumously published in 1888 with an introduction by JOEL CHANDLER HARRIS.

RUSSELL, JAMES EARL (1864-), American educator, was born at Hamden, N.Y., July 1, 1864. He graduated from Cornell in 1887, and studied at the universities of Jena, Leipzig and Berlin, 1893-95, serving simultaneously as European commissioner of the New York State department of education and the United States Bureau of Education. After holding the chair of philosophy and pedagogy at the University of Colorado, 1895-97, he went to Teachers College, Columbia, becoming dean of Teachers College in 1898. In 1927 he was made dean emeritus. He is the author of many education publications.

RUSSELL, LORD JOHN (1792-1878), English statesman, was born in London, Aug. 18, 1792. He was educated at Edinburgh University. Entering parliament from Tanistock in 1813, he early attained prominence by his strong advocacy of reform measures. Failing in his opposition to the repressive measures of 1817, he resigned but was returned from Devon in the following year. Serving from Huntingdon from 1820 to 1826, he gave strong support to the Catholic Emancipation Act thus losing the Huntingdon support only to be returned from the Irish borough of Bandon Bridge. He succeeded in having the Test Acts repealed in 1828. He became paymaster general in 1830 in the reform ministry of Lord Grey and championed the Reform Bill which was passed in 1832. In 1835, Russell became home secretary and leader of the House of Commons; in 1839

secretary of state for the colonies. He formed the government in 1846 and was premier for about six years. This term was notable chiefly for the strong but sympathetic handling of the Irish situation. Upon the formation of a new government he became foreign secretary and in 1854 president of the council. He represented England at the Vienna conference in 1855 and returned to assume the post of secretary of the colonies only to resign two months later. In 1860 he became foreign secretary and the following year was made an earl. Russell was again premier in 1865 but, forced to resign, he retired from political life the following year. He died at Richmond Park, May 28, 1878.

RUSSELL, LILLIAN (1861-1922), American actress, was born at Clinton, Ia., Dec. 4, 1861. Educated in the Convent of the Sacred Heart at Chicago, Ill., she went to New York in 1879 and studied for grand opera under LEOPOLD DAMROSCH. Chiefly associated with the Casino Theatre, New York, she created the title rôles in *Dorothy*, *The Grand Duchess*, *La Pénichole* and *Erminie*. She was regarded for many years as the most beautiful woman on the American comic-opera stage. She died at Pittsburgh, Pa., June 6, 1922.

RUSSELL, WILLIAM FLETCHER (1890-), American educator, was born at Delhi, N.Y., May 18, 1890. He graduated from Cornell University in 1910, and took his Ph.D. at Columbia in 1914. He was dean of the college of education, State University of Iowa, 1917-23, and professor of education and associate director of the International Institute, Teachers College, Columbia University, from 1923-27, becoming in the latter year dean of Teachers College. His publications include *Economy in Secondary Education*, 1916; *Schools in Siberia*, 1919; *Schools in Bulgaria*, 1923.

RUSSELL SAGE COLLEGE, at Troy, N.Y., a privately controlled, non-sectarian college for women founded in 1916. The college was established through the generosity of Mrs. Russell Sage and named in memory of her husband. The productive funds in 1931 amounted to \$902,939. The library contained 10,641 volumes. In 1931-32 there were 445 students and a faculty of 45, headed by Pres. Lawrence Meader.

RUSSELL SAGE FOUNDATION, a fund created by Mrs. Russell Sage as a memorial to her husband "for the improvement of social and living conditions in the United States of America." It was incorporated in 1907 by the legislature of New York. The original endowment of \$10,000,000 was increased by \$5,000,000 by her will. The activities of the foundation include research, publication, education, establishment and maintenance of charitable and benevolent agencies, and aid of other such agencies already established. While the foundation makes a few grants to other agencies with kindred purposes, it carries out its program chiefly through its own departments. The publications of the foundation in 1930 numbered about 100 books and 400 pamphlets, touching practically every field of social work. One

of the major interests of the foundation in recent years has been the preparation of a regional plan for the development of the metropolitan area of which New York City is the center.

RUSSELLVILLE, a city and the county seat of Pope Co., in western Arkansas, situated near the Arkansas River about 80 mi. northwest of Little Rock. Bus and truck lines and two railroads serve the city. Cotton and fruit are the chief crops of the vicinity, and lumber products, harness and leather specialties and cotton compresses are the principal manufactures. Russellville is the southern gateway to Ozark National Park and Diamond Cave. It is the seat of the Arkansas Polytechnic College. Pop. 1920, 4,505; 1930, 5,628.

RUSSIA, the general designation for what is more properly known as the Union of Socialist Soviet Republics, that vast section of Europe and Asia whose area of 8,200,000 sq. mi. comprises almost one-sixth of the globe, its largest continuous political domain. On the north Russia reaches to the frigid Arctic Ocean and its seas; its southern boundaries are the Black and Caspian seas in Europe, and Persia, Afghanistan, Mongolia and Manchuria in Asia. Beyond its eastern shores is the Pacific Ocean, and to the west lie Rumania, Poland, Lithuania, Latvia, Estonia and Finland.

The name Russia was first employed by the Scandinavians who founded a state on the Dnieper in the 9th century; it is probably a corruption of *rothsmenn*, the Swedish word for seamen.

In proportion to its area Russia has but little accessible coast line, its seaports being restricted largely to the Gulf of Finland and the Black Sea. Russia occupies a transitional position between the Oriental civilizations of southeastern Asia, China and India, and the white peoples of western Europe. Its population is very unevenly distributed. About three-fourths of the inhabitants of Russia are concentrated in the triangle formed by Leningrad in the west, Odessa in the southwest and Omsk in western Siberia, an area embracing only about 15% of Russia.

The present Union is composed of seven republics, the largest of which, the Russian Socialist Federated Soviet Republic, constitutes 93% of the total area, including 11 regions in European Russia, the greater part of Siberia, and the Far East, as well as 11 autonomous republics and 15 autonomous areas. In addition, the U.S.S.R. comprises the White Russian and Ukrainian republics in western and southern Russia, the Transcaucasian Federation of Armenia, Georgia and Azerbadjan, and the Uzbek, Turkmen and Tadjik Republics of central Asia.

Surface Features. On the whole, Russia is to be characterized as a country of vast plain areas which exhibit, however, a wide diversity of features ranging from the treeless, wind-swept tundras of the extreme north to luxuriant forest stretches, both coniferous and deciduous, the rich, low farming lands of the south, and the arid steppes of central Asia and parts of Siberia. Its principal mountain range, the Urals, pro-

vides in part a boundary between the European and Asiatic sections, and a dividing line for river drainage directions. European rivers drain south to the Black and Caspian seas; beyond the Urals, the general river courses, with few exceptions, are north to the Sea of Aral or even to the Arctic Ocean. In European territory is the VOLGA RIVER, longest in Europe, which receives many large tributaries and winds for more than 2,000 mi. from its source in the northern Valdai Hills to its outlet in the Caspian. The mighty Don and DNIEPER are likewise great streams flowing within European Russia.

In southeastern Europe are the Caucasus Mountains, where Mt. Elbruz, loftiest peak on the continent, rises to a height of 18,465 ft. The range, which overlooks fertile valleys of subtropical vegetation, provides a natural boundary between Europe and Asia. In its valleys flow the important Rion and Kur rivers and numerous smaller streams. The various less consequential mountain ridges of Central Asia are very rugged as they proceed from BAIKAL, largest inland lake in Asia, to the Pamirs. In Siberia the extensive Altai Mountains are of outstanding significance because of the mineral wealth they possess.

Northern Russia west of the Urals is distinctly lake country. The largest of these bodies of water, Ladoga and Onega, rank in size respectively first and second among European lakes. Here are the headwaters of a number of great rivers, including the Petchora and Dvina. The plains of the north extend for miles over a region whose level stretches lie unprotected from arctic cold. Beyond the mountainous Ural region are situated the high plateaus of the Yenisei area, watered by the Ob, Yenisei and Angara river systems, which, with the Lena, comprise the leading waterways of Russia's Asiatic territory. From here to the eastern boundary the land is generally elevated.

One of the most remarkable physical distinctions of the Soviet Union is the number and extent of its inclosed seas; in Europe lie the Black and Caspian seas and the Sea of Azov, while the Asiatic division has the Aral and Lake Balkhash, which is rightly considered a sea.

Climate. Russia's distance from the ocean and from the influence of sea winds accounts for the essentially continental character of its climate. The temperature displays unusual diversities, from continuous subarctic cold to subtropic heat, with numerous variations between these extremes. Winters are on the whole extremely cold, and even in Odessa, with its southern situation, the average January temperature is -3.7° C. Siberia's climate is the coldest on the globe. The summers, though brief, are generally hot, even in northern Leningrad, where 17.7° C. is the mean July temperature. In the Turkestan desert summer heat attains 40° C.

Remoteness from the ocean is responsible for the comparatively low rainfall. The regularly distributed rainfall prevalent in the northern areas has preserved Russia's great forest regions, while the light spring and summer showers general in parts of the Ukraine

and throughout western Siberia have resulted in the vast dry plains known as steppes. Except for the malaria rampant throughout the moist and swampy areas of the lower Volga, Russia's climate is dry and healthful.

Flora. Russia in general is not noted for the richness or diversity of its flora. The prevailing forms of vegetation in the barren wastelands of the north are mosses and lichen. Of first importance are the native forests below the arctic belt, the *taigas*, which in Siberia and Russia proper are composed of dense growths of evergreens, largely spruce and pine; in central Russia and the Caucasus are found forest tracts abounding in deciduous species, principally oak, birch, beech and ash. The black-earth areas of southern European Russia, mostly confined to the Ukraine, are generally characterized by numerous species of native grasses. The Don River serves as a natural division between the luxuriant growths of its western plains and the vegetable poverty of the marshy or arid steppes stretching eastward.

Fauna. The variety and quantity of its fauna is a considerable item in the Soviet Union's national economy, for fur and fish exports are highly important. In the cold northern regions arctic foxes, polar bears, sables, ermines and reindeer exceed other animals numerically; on these coasts are found many seals. Generally indigenous throughout the Union are bears, foxes, lynxes, wild boars, hares, wolves, elk and other species of deer. Beavers occur in White Russia only, while in the south are smaller animals, such as foxes, squirrels, hares and suslik and baibak.

Birds are found in greatest numbers in the forest regions, and native species such as partridge and grouse are common. Upon the Siberian tundras wading birds, tundra swans, geese and barnacles abound; the *taigas* are noted for their singing birds, woodcocks and large birds of prey. On the steppes typical birds are snipes, bustards and ducks. The most important fish are cod and salmon, which are native to north-western Russia and the eastern coast, and herring and sturgeon, found in vast quantities at the mouths of the Don, Volga and Ural rivers.

Mineral Resources. Exploitation of Russia's very extensive mineral wealth is just beginning. It is estimated that the country has coal reserves of 600,000,000,000 metric tons, one-eighth of which is anthracite. The principal coal areas are the Kuznetz Basin of Siberia, where 100 mines were expected to be operating by 1933, the Donetz Basin of southern European Russia, the Far East, the Urals, Central Asia, and central Russia. Mechanization of production has been introduced in the Donetz Basin, which is at present the country's chief coal field, and in most of the smaller producing areas. Peat, estimated at 548,816,000 tons, is found chiefly throughout Russia proper and Siberia.

Practically three-fourths of the world's oil wealth is found in the Soviet Union, where estimates place petroleum reserves at 30 to 40 billion barrels. Oil resources are yet to be studied geologically. The outstanding producing regions are the Baku and Grozny

oil fields, which yield over 95% of the total; in Baku, oil production has been continuous since 1863.

Iron ore deposits are very considerable, with surveyed deposits amounting to about three billion metric tons, exclusive of the Kursk magnetic iron reserves, which were discovered only in 1925. The Krivoy Rog district in the Ukraine now supplies over three-fifths of the iron-ore output. Manganese deposits in the Georgian Republic are the most important in the world; there is also much manganese in the Ukraine, Urals and Siberia. The total reserves of manganese in the U.S.S.R. are estimated at from 220,000,000 to 250,000,000 tons.

Copper in large quantities is mined in the Urals, the Caucasus, the Donetz Basin and Siberia; the last region also supplies gold, notably from the Aldan and Lena gold fields. Rich platinum deposits in the Urals are now being exploited; this industry was paralyzed completely during the World War. Other minerals found in various parts of the Union are precious stones from the Urals, silver, lead, asbestos, salt, zinc, tin, aluminum, nickel, mercury, chromium, phosphates, bauxite and potash.

Forests. Russia's forest resources are generally regarded as being the greatest in the world, the forest area covering more than two billion acres, about one-third of the world's total. These forests are largely in the Russian S.F.S.R., which includes Siberia. Siberia's dense forests are almost entirely coniferous, composed principally of pine and spruce trees. Cedar and fir trees are likewise numerous. Deciduous trees are found chiefly in the Caucasus, where oak, beech, ash and birch abound, and in Russia proper. About 18% of this forest land has been put to productive use, but the lumber industry is rapidly expanding nevertheless. The revenue from timber and its products forms a substantial portion of the national budget. Total lumber exports in 1929-30 amounted to \$92,000,000. Exports over the European frontier amounted to almost \$42,000,000 in 1928-29, of which nearly 40% went to Great Britain. Pulpwood and veneer make up large shipments. The industry is largely controlled by state trusts, the six major companies operating in the White Sea region, the Karelian Republic, the Leningrad Region, the Western Dvina area, White Russia, and the Far East.

Soil. The variety of Russian soils ranges from among the poorest to possibly the richest on the globe. The treeless tundras which stretch across all northern Russia, both European and Asiatic, are dry and unsuited for agricultural development. The *podzol* or potash-soil of the coniferous forest zones which cover a very considerable portion of the Union is poor in humus and exhausted by moisture; and the marshy plains covered with dwarf birch in Asiatic Russia south of the tundras occupy an extensive area, as do the deserts and wastelands of Central Asia.

Russia's earliest village settlements arose along the ravines which border its rivers, while the plateaus were until recently left uncultivated. The introduction of modern agricultural methods is converting

many miles of sparse steppe vegetation into wheat and rye fields. The marsh areas and the bog lands common in central Russia are the nation's chief sources of peat.

It is in the south, in south central Russia, the Ukraine and the Volga region about Samara, that the richest soil is found, the black earth or *chernozem*; Russia's preeminence as one of the world's greatest granaries is directly consequent upon black earth productivity. Here the forests are deciduous and the steppe soil fruitful.

Agriculture. Russia has always been and is to-day a strongly agricultural country. About 83% of the population is engaged in the cultivation of the soil, the great majority raising wheat and rye. Over 250,000,000 acres were sown to grain in 1930. The crop land lies in all sections of the domain, from the richly productive black earth region of the Ukraine and the vast Siberian plains where grain is produced in tremendous quantities, to the subtropical reaches of Azerbaijan and Ferghana where tea is grown and where cotton culture is developing rapidly.

Under the Tsarist régime, agriculture with primitive methods was pursued by peasants who cultivated small areas throughout European Russia and the Ukraine. To-day, although titles to all land are held by the state in trust for the people as a whole, and no land is privately owned, peasants control about 90% of the total sown area. Only 30% of the total sown area is sown by individuals, over 60% being sown by peasants united in collective farms. The other 10% is composed of state farms. State farms or *sovhozes* are directly controlled by the Soviet Government, while collective farms or *kolkhozes* are voluntary consolidations of individual peasant holdings jointly operated by the peasants. The latter have shown especially rapid growth during recent years. While the collective farms in 1928 had a sown area totalling 3,376,000 acres, by the spring of 1931 they had sown over 145,000,000 acres, or 61% of the spring sown area. In 1928 the collective farms embraced only 416,700 householders, or 1.7% of the total, but by Oct. 1931 they represented 15,250,000 householders, or 61%.

Tractor stations, lectures, experimental seed stations, are progressive aids to agriculture which are being advocated and practiced to increase production on all farms. The system of rotating crops has been successfully introduced throughout the Union; equally important have been the recent organization of irrigation projects, the combating of plant diseases and the improvement of culture. Almost every variety of plant can now be grown within Soviet territory. The Commissariats for Agriculture in the seven constituent republics and their local organizations supervise the tilling of the soil.

Grain is the principal crop, the sown area now grown exceeding the pre-war level. Russia, with nearly one-third of the world's cultivated agricultural area, is one of its chief granaries. The principal grain crops are wheat and rye; other valuable harvests are oats, barley, corn, millet and buckwheat. In 1930 the

production total of grain amounted to about 87,000,000 metric tons. In 1926, 45,000,000 metric tons of potatoes were grown in the European area.

Very important also, in Central and White Russia, is the production of flax. Flax, hemp and sunflowers produced oil seeds in vast amounts, mostly intended for export.

Sugar beets in the Ukraine, a coarse tobacco called *makhorka*, and cotton in the southern Asiatic areas are other leading crops. New cotton regions have been opened up and developed, particularly in Central Asia and Kazakstan, due largely to the opening in 1930 of the Turkestan-Siberian Railway, and numerous irrigation projects are under way in Central Asia. Cotton and jute substitutes are the subjects of intensive experimentation.

The fertile soil of the south, the black-earth area, makes that country particularly adapted for the cultivation of wheat as well as for a variety of vegetables and fruits for local consumption. Tobacco, wine and tea are grown in increasing quantities near Batum.

Animal Industry. After the serious setbacks caused by war and revolution, live stock consisting principally of horses, cattle, sheep, goats and hogs, now exceed the pre-war figure. The 1927 figures were, in thousands of heads: horses, 30,391; cattle, 67,327; sheep, 121,739; goats, 9,340; hogs, 20,222. The number of Russia's horses form one-third of the world's total. On State farms the number of head of sheep in 1930 was estimated at more than two and one-half millions, and the textile industry is using larger amounts of domestic wool yearly. The production of milk has also increased, and with it the making of butter, of which exports are considerable.

The fish catch in 1930 amounted to about 1,250,000 metric tons, the chief exports including much salmon from Kamchatka, black caviar, red caviar and fish glue. Fishing is controlled by 11 State trusts located in the various fishing centers, of which the greatest is the Volga-Caspian Fish Trust operating at the mouth of the Volga. Of the total catch about 10% is frozen, 2% canned and the rest salted or smoked. Fish resources are extremely valuable, the Soviet Union's catch ranking second in the world. Modern methods now being introduced are materially aiding further development of the industry. The leading fisheries are in the Volga-Caspian region, the Arctic-White Sea and the Far East. Caviar is the most valuable fish product.

Furs, coming principally from the Asiatic portion, constitute a valuable source of revenue, the Siberian and Far Eastern Regions and the Kazak and Uzbek republics providing the greater part of the annual catch. The leading furs for export are squirrel, wolf, lynx, fox, sable, ermine, hare, suslik, kolinsky, mink, fitch, marmot, *burunduk*, badger, caracul, krimmer and pony.

Industries. Practically all large-scale manufacturing projects are under the supervision of the Supreme Economic Council of the Soviet Union. Only 2.5% of the industrial output of the country is accounted

for by private production. Among the private enterprises are about 35 projects conducted by foreign concessionaires and a number of small-scale handicraft industries carried on by individual artisans or workers grouped into industrial organizations called *artels*. Manufacturing now exceeds the pre-war figure, but progress has been steady, and modern methods are now rapidly replacing the more primitive.

The large industrial centers are chiefly located in central Russia, although it is a government policy to establish all new factories near the source of supply. Among the foremost manufactured products are sugar from the Ukraine, and textiles from the Ivanovo-Vosnessensk district. There are also important new textile developments in Armenia, chiefly at Leninakan.

Automobiles, many kinds of machinery, glass, porcelain and numerous other products are produced at Nizhni Novgorod, which ranks as a great manufacturing and trading center; tractors and agricultural machinery are being built in Stalingrad and in factories scattered throughout the southern European area; leather factories are numerous in the Ukraine. Steel, electrical supplies, artificial fiber, airplanes, boilers, turbines and all kinds of industrial machinery are new items in Russian manufacture, and their production is being hastened. Other noteworthy manufactures are chemicals, tools, matches, metal products, paper, tobacco, vegetable oil and food products.

Communications. Tremendous demands upon the transportation system have resulted from the recent development of agriculture and industry; and despite the fact that 40% more freight and passengers were carried in 1929-30 than in the preceding year, and twice as many as in 1913, the railways were inadequate for the demand. In regard to railways the Five Year Plan has been revised to try to meet these needs.

Although Russia is two and one-half times as large as the United States, the total railroad mileage is only one-fifth as great. High-powered locomotives, improved methods of changing cars and locomotives, unification of junctions and decrease in time required for rolling-stock repairs, and the consultation of American railway experts are remedying the unsatisfactory conditions brought about by the war and revolution.

The new railway construction plans show a movement toward the east, important lines being built to develop the natural resources of Kazakstan, Central Asia, the Urals and Siberia. The outstanding example is the Turkestan-Siberian Railway, completed in 1930 at a cost of \$100,000,000, which links Siberia, Kazakstan and Central Asia for the exchange of cotton, grain and lumber. Other valuable new lines connect Saratov with Millerovo, Orenburg with Ufa, Tomsk with Yeniseisk, and Briansk with Vyazma.

Road building for the accommodation of trucks and buses is also being pushed to supplement the railways. Improved dirt, gravel, tar, and the latest type of modern roads are called for under the Five Year Plan. Russia's first air line was established in 1922, linking Moscow with German cities; at the end of

1930 the total length of air lines was estimated at 161,500 mi. The Trans-Asiatic Air Line from Moscow to Vladivostok, inaugurated in 1931, is an important link from east to west. Nikolaevsk, on the Amur, is a leading airport, and Central Asia is regarded as the great future center for aviation.

Inland waterway traffic was seriously hampered during the revolutionary period but is now recovering. By 1933, 62,137 mi. of navigable waterways were expected to be available and 111,846 mi. for floating logs. River transportation is yet very crude, modern boats and new equipment being scarce. Surveys for the Volga-Don Canal were made in 1928 and when completed will result in giving the Volga a sea outlet and thereby raise the river freight to 6,000,000 tons a year. Other canals have been projected in Siberia and the Urals. The dam across the Dnieper River, in connection with the Dnieper River power plant, will result in making this river navigable for practically its entire length.

The Soviet merchant marine is unimportant, and the turnover from Russian ports is generally below the pre-war level, except for Vladivostok, Novorossisk and Batum. Other important ports are Leningrad, Murmansk, the most northerly port in the world, Archangel and Odessa.

Postal, telegraphic, telephone and radio service are all under the control of the People's Commissariat for Posts and Telegraphs. From 12,000 in 1913, post offices had increased to about 250,000 in 1928; in 1927 there were almost 58,400 mi. of telephone lines and 90,100 of telegraph wires; radio communication is extensively employed, 57 broadcasting stations being in operation in Mar. 1928.

Commerce. Domestic trade is handled by state, cooperative and private enterprises. The Nizhni Novgorod annual fair is an important and spectacular feature of internal trade and of commerce with the east. Internal commerce includes machinery and consumer's goods, being made up of trade in grain, vegetables, meat, dairy products, fish, vegetable oil, salt, sugar, tea, liquor and tobacco, and such commodities as dry goods, shoes, metals, chemicals, kerosene, and paper.

Foreign trade is transacted entirely through State agencies, while the actual selling and purchasing abroad is handled by special organizations in the various countries, such as the Amtorg in the United States. Business has been impeded by the lack of adequate credit arrangements and antagonism on the part of foreign powers, but both exports and imports are on the increase. In 1929-30 Soviet trade showed an excess of more than 66,000,000 rubles of imports over exports.

Articles sent out in return for foreign goods are products of the soil such as wheat, rye, barley and flax; animal products, such as undressed skins, casings, eggs, poultry and bone; furs, fish and fish products; manufactured articles such as matches, art and handicraft products, bone glue and meal, chemical and pharmaceutical products and textile piece goods; lumber, plywood, oil cake, confectionery, manganese, iron ore, coal and oil products. These and other articles bal-

anced the chief imports, among them industrial, agricultural and automotive equipment, citrus fruits, spices, coffee, cocoa, tea, rice, hides and live stock; wire, iron and steel manufactures; raw cotton, raw jute and kenaf, silk, wool, knitted goods, rubber and rubber articles, seeds, chemicals and fertilizers. Foreign capital, from European and American firms, is developing a number of concessions.

Finance. Since the stabilization of the currency in 1923, the monetary unit has been the *cheinovetz*, paper money issued in bank notes of 1, 3, 5, 10 and 25. A *cheinovetz* equals 10 gold rubles of 100 *kopek*s each. Rubles are roughly 50¢ in United States currency. Other bills are those for 1, 3 and 5 rubles, there are silver coins of 10, 15, 20 and 50 *kopek*s and for 1 ruble, and copper coins of 1, 2, 3 and 5 *kopek*s.

Soviet money has circulation only within the country, both exports and imports by individuals being illegal. There are two types of currency: notes of the State Bank, backed with precious metals and foreign currency; and treasury notes, to an amount almost equaling the State bank-note issue. There are also silver, copper and bronze treasury coins. The total circulation in 1931 exceeded four billion rubles.

The State Bank was founded in 1921, to regulate the currency circulation and provide short-term credits for industry, agriculture, commerce and transport. The management is responsible to the government. It is the central credit institution of the Soviet Union, and has wide power of control over other banks; its resources are derived chiefly from the issuing of bank notes, Soviet Government deposits of enterprises and individuals. Other important banks are the Bank for Foreign Trade, the All-Union Cooperative Bank and the Central Agricultural Bank. There are many local savings institutions and agricultural credit societies. The system comprises some 1,500 units, exclusive of the savings banks, which numbered 20,000 in 1929.

Defence. The Military Revolutionary Council of the Soviet Union has direct charge of the Red army and navy, and controls its movements on land and sea. Since 1924 the Red army has maintained a constant of 562,000 men, as against the pre-war peacetime strength of 1,400,000; military service is obligatory except for persons of certain categories who are deprived of the franchise. For those drawn, the service extends over 21 years, between 19 and 40, although active service is restricted to from two to four years. The navy comprises the Baltic, Black Sea, Caspian Sea, Far East, Arctic and White Sea fleets, and has four battleships. There is also a military air force.

The Red army and navy are composed almost entirely of peasants and workers, most of whom are Russians or Ukrainians. Both the army and navy conduct vigorous educational programs.

Religion. Freedom to profess all religions prevailed from the 1917 revolution until 1929, when laws restricting liberty of worship, such as the prohibition of religious propaganda and the disenfranchisement of the clergy, were instituted. Atheism is virtually

the state religion, disseminated under the control of the Commissariat for Education, and taught to the exclusion of other beliefs. The Greek Orthodox faith still retains many adherents, as does Roman Catholicism in the former Polish provinces, the Lutheran faith in the Baltic region, Mohammedanism in the east and south and Judaism in the western and southwestern provinces of European Russia.

Education. See RUSSIAN EDUCATION.

Government. The Union of Socialist Soviet Republics is a voluntary centralized federation of seven constituent republics, each of which includes autonomous republics and areas. Sole jurisdiction over foreign relations and domestic affairs relating to the entire Union, and supervision of general welfare problems such as health and education, rest with the central government, while autonomy is retained in the field of local administration. For further details on the Soviet government, see UNION OF SOCIALIST SOVIET REPUBLIC.

Population. Estimates of Russia's population in 1931 place the figure at over 161,000,000. The population of the major divisions was: Russian Socialist Federated Soviet Republic, 110,932,500; Ukraine, 31,403,200; White Russia, 5,246,400; Transcaucasian Federation 6,426,700; Turkmenistan, 1,137,900; Uzbekistan, including Tadjikistan, 5,859,500. The population of the largest cities was: Moscow, 1931, 2,745,000; Leningrad, 1931, 2,228,300; Kiev, 1926, 513,637; Baku, 1926, 453,333; Odessa, 1926, 420,862; Kharkov, 1926, 417,342; Tashkent, 1926, 323,544. See separate articles on these cities.

The Russian people of Europe, excluding Jews, are made up of three races: the Slavs, the Finns and the Mongol-Tatars. The Slavs, by far the most numerous, are the true Russians. They partly drove out and partly absorbed the original race, the Finns, who, except a comparatively few Germans, are the only real Europeans of Russia. The Slavs or Russians, as were the aboriginal Finns, are of two racial types: first, the tall, long-headed, reddish-blond type of the northwest and, second, the short-statured, round-headed, dark-complexioned type of the southeast. The true Russians or Slavs are divided into three divisions: the Great Russians or Muscovites, the Little Russians or Ukraine people, and the white or Western Russians. The other peoples are the Finnic races (not to be confused with the inhabitants of Finland), the Mongols, few in number, and distinctly Asiatic, and the Oriental Tatar-Turks of Crimea. There is a large Jewish population, estimated at 3,000,000 in the Ukraine.

More than 180 nationalities, speaking about 150 languages or dialects, live in the Union; 53% of the total population is Russian, 21% Ukrainian, and 3% White Russian. Other large groups are Kazaks, Uzbeks, Tatars, Jews, Georgians, Azerbadjan Turks, Armenians, Mordvinians, Germans, Chuvashes, Tadjiks, Poles, Kirghizes, Turcomans, Bashkirs and Votyaks. The Soviet policy encourages racial and cultural autonomy among all nationalities.

RUSSIA, HISTORY OF. The western portion of modern Russia has been inhabited by Slavic stocks

at least from the 1st millennium B.C., and the area from the middle Vistula eastward to the Dnieper was the starting point for all subsequent Slavic expansion. Early in the 9th century A.D., adventurous Swedish vikings, inspired by the hope of developing trade relations with the Orient via the Russian watercourses, began to establish trading posts on Lake Ladoga and along the rivers to the south and east. They made their first contacts with Russian Slavs in the vicinity of Lake Ilmen, which was one of the northern outposts of Slavic migration. By the middle of the 9th century, these Varangians crossed the watersheds separating the valleys of the Dvina and Lovat from the Dnieper, and began their advance to the Black Sea. Such trading posts as already existed they took under their armed control, and thus established themselves as a militant but commercially minded ruling class. While maintaining close contacts with Scandinavia until the 12th century, the Varangians were actually Russified with great rapidity. The Varangian princes of Kiev soon won supremacy over adjacent Slavic tribes and Norse immigrants. Business and political relations with Byzantium speedily paved the way for Greek intellectual influence.

Christianity Adopted. The princess Olga, widow of Igor (traditionally the son of Rurik, founder of the Russian princely house), was the first member of the ruling family to adopt Christianity, 957, while her son Svyatoslav, though an obstinate pagan, was keenly aware of the importance of commercial contacts with the Balkans. The son of Svyatoslav, Vladimir I, expanded his authority into Volhynia, reduced new Slavic tribes to subjection, and sought to increase his prestige by marital alliance with the Byzantine royal house, the chiefs of which had sought his military aid. The result was Vladimir's marriage to Anna, sister of Basil II and Constantine VIII in 988, his conversion, and the adoption of Christianity as the national faith. Upon Vladimir's death in 1015, the contested succession devolved upon his second son Yaroslav, born of a Scandinavian mother. Through dynastic intermarriages, Yaroslav gradually became related to many of his outstanding European contemporaries. He initiated the building campaign which made Kiev one of the great cities of the 11th century, and devoted special care to the promotion of art and literature. In 1034 he succeeded in definitely crushing the Pechenegs, menacing nomads of the steppes. During his principate, customary law was crystallized in the code known as the *Russkaya Pravda*. Russia was more truly a European state in Yaroslav's day than at any epoch prior to Catherine II; but the principate of Kiev carried the germs of its decline in the system of dynastic succession which he set up. After the death of Yaroslav, this system resulted in a period of disorder which terminated only when the throne of Kiev fell in 1113 to the lot of Yaroslav's popular and energetic grandson Vladimir Monomakh.

The strife preceding the accession of Vladimir Monomakh and renewed after his death in 1125 was aggravated by constant nomad attacks. Some 30

years after Yaroslav's elimination of the Pechenegs, they were replaced as a menace by the Polovcians, likewise of Turkish stock. Only by concerted action could the Russian princes successfully beat off their raids. By the middle of the 12th century, however, the conception of national unity prevalent under Yaroslav had given way to a clear separation into mutually hostile subdivisions ruled over by kindred branches of the princely family. The individual principalities were impoverished, the nomad raids paralyzed agriculture in the southern black-earth region, and commerce with the Byzantine Empire came to a standstill. Kiev was almost a deserted city.

National Unity Broken. In the 13th century, the southern principality, after a century and a half of dominance, thus yielded its supremacy to other centers more remote from the nomad threat: the commercial state of Novgorod, destined to fame for its commerce with the Hanseatic cities; the principality of Suzdal-Vladimir (centering some 75 miles northeast of modern Moscow), the nucleus from which the Muscovite State eventually sprang; and finally, the city of Galich, on the Dneister, the chief strong point of Galicia and Volhynia before the Tatar invasion. The development of these centers was favored by a pronounced migratory movement away from the points in the southern Dnieper basin most subject to nomad attacks. Originally a principality of which the territory embraced practically all European Russia north of the upper Volga, Novgorod in the 12th century cast aside the remote authority of Kiev, and by winning the right to elect both their prince and their archbishop, the inhabitants assured their political independence. A similar republican régime prevailed at Pskov. The chief early centers in eastern Russia were the cities of Rostov and Suzdal. This region first became an independent principality in 1097 under Vladimir Monomakh, who bequeathed it to his younger son Yuri Dolgoruki (George Longarm), the founder of Moscow. The descendants of the younger son of Vladimir Monomakh thus became irrevocably identified with the district in which the Muscovite power developed, and where their line ruled for 12 generations until extinguished at the death of the sons of Ivan the Terrible. The principality of Volhynia, long an appendage of Kiev, became independent of the latter toward the middle of the 12th century. After absorbing Galicia about 1200, it included the portion of modern Poland east of the upper Vistula and south of the Bug. This state was fundamentally aristocratic in composition, and the nobility played a rôle analogous to that developed by the Polish nobles in opposition to the royal authority. Apart from these three major centers, Russia by the beginning of the 13th century also comprised a number of less important principalities exposed to the influence of their more powerful neighbors. All sense of national unity was lost, and cooperative action against a common foe became impossible.

Supremacy of Tatars. The Russian principalities were rudely shaken in 1223 by the invasion of

eastern nomads more ferocious than any previously encountered. Against the advancing Tatars even the Polovcians invoked Russian aid, but the invaders routed the Russian princes at the Kalka, and mysteriously withdrew. Fourteen years later they returned in mass under Baty, nephew of Genghiz-Khan. Having subjected northeastern Russia, Baty transferred his attentions to the Dnieper valley, burned Kiev in 1240, and moved across the Carpathians. Only the death of Ogdaï, successor of Genghiz-Khan, in 1243 saved western Europe from the fate of Russia. Baty then proceeded to consolidate his Russian conquests, and for the next two centuries and a half the Tatar was a factor in Russian history which left an indelible impress on the national civilization and government. Though they imposed heavy taxes and tribute on the subject population, the Tatars usually left the local princes and clergy in authority, and the Church gained extensively in influence and resources during the Tatar supremacy.

The princes of Suzdal and later of Moscow took the lead in reorganizing the country distraught by the Tatar incursion. Moscow itself, previously a mere hunting-lodge and border fortress, began to gain in importance as a junction of routes from north to south Russia and from Novgorod to the eastward. As Prince of Moscow, Ivan Kalitá (the Bursar) was able in 1328 to take over the senior principality of Vladimir, and thus to lay the foundation for Muscovite dominance. Ivan not only reestablished domestic tranquillity but is also credited with having induced the Tatars to allow the Muscovite prince to act as their collection agent, thus obviating the oppression of the Tatar fiscal representatives. Finding Kiev too exposed, the metropolitan of the Russian Church had moved to Vladimir about 1300. In Ivan's reign, the metropolitanate was transferred to Moscow, which thus became the admitted administrative and ecclesiastical center. Ivan's grandson Dmitri Donskoi not only added to his territories but in Aug. 1380 defeated the Tatars in a decisive engagement on the Don. Unfortunately, however, his losses were so great that he was unable to withstand a Tatar punitive expedition two years later. Moscow was burned to the ground, while Dmitri was once more reduced to vassalage. The next 80 years, during which the disintegration of the Tatar power continued apace, were filled with isolated Tatar raids and complicated by strife among the Russian princes.

North Russia Consolidated. Two generations passed before an intelligent and resolute ruler arose in Moscow in the person of Ivan III, 1462-1505, who consolidated for the first time all north-Russian territory under Muscovite rule, subjugating Novgorod, 1478, and absorbing Ryazan and Tver, 1485. The dynastic eminence of Ivan had been consecrated by his marriage in 1472 to the Byzantine Princess Sophia Palaeologa, who brought with her to Moscow a considerable retinue of Greek and Italian priests, artists and scholars. After this union, Ivan adopted a more autocratic attitude than had previously characterized

him. He established peaceful relations with the Tatars in the Crimea and at Kazan, and avoided decisive action with the Golden Horde until it spontaneously collapsed in 1502, thus ending the Tatar supremacy. Muscovite territory nearly trebled under Ivan's energetic stewardship, and he was able with propriety to arrogate to himself the new imperial title of Tsar (Caesar) and thus to assume the rôle of legitimate successor to the Byzantine emperors. The Muscovite policy of expansion was continued by Ivan's son Basil III, who subjugated Pskov and captured from the Lithuanians the important strategic center of Smolensk.

Upon the death of Basil in 1533, Ivan IV (the Terrible), his son and heir, was three years old. Until the age of 16 he was surrounded by the bad example of cruelty, jealousy and double dealing on the part of the nobles who were supposed to protect his interests. These early experiences affected his mind, so that Ivan was mentally unbalanced from boyhood. He was crowned Tsar in 1546; under capable advisers, the early part of his reign passed off brilliantly. Upon the death of his first wife in 1560, the Tsar's character altered. He cast aside his old counselors and came into conflict with the nobility. To exterminate the latter, he established a special military corps, the *oprichnina*, who initiated against the aristocracy a reign of terror which eventually disordered and impoverished the whole realm. Ivan's territorial acquisitions were notwithstanding considerable: he conquered Kazan and Astrakhan, entered into direct commercial relations with England via the White Sea, and witnessed the conquest of Siberia by Yermak.

Since Ivan, in a fit of temper, had accidentally killed Prince Ivan, his eldest son, the crown devolved in 1584 upon his younger son, Theodore, a pious, weak and irresolute recluse. The rôle of regent eventually fell to his brother-in-law, the able and unscrupulous Boris Godunov, whose ambitions aimed directly at the throne. He thus stifled an aristocratic conspiracy which purposed to divorce his childless sister from the Tsar, and exiled to Uglich Prince Dmitri, the second surviving son of Ivan IV. Dmitri met a mysterious death in 1591, and Theodore himself died in 1598. Godunov was then elected as the latter's successor. He pursued a conciliatory foreign policy, endeavoring as far as possible to heal the economic wounds suffered under Ivan IV. His intentions in this respect were nullified by the famine of 1601, and by the sudden appearance in 1603 of a pretender backed by Polish intrigue and calling himself Dmitri, son of Ivan the Terrible. Boris died suddenly while the pretender was advancing on Moscow, and the nobles hostile to Godunov betrayed his son to the invader. Popular discontent and aristocratic hostility soon brought about the ruin of the False Dmitri, 1606. For the next six years, Moscow was a prey to various short-lived princes and the vicissitudes of Polish intervention and invasion.

Rule of the Romanovs. Toward the end of 1612, a popular uprising finally swept the Poles out

of Moscow and in January of the next year, a specially convoked national assembly elected as Tsar Michael Romanov, 17-year-old son of the metropolitan Philaret. The new Tsar faced numerous problems of pacification. In 1617, by treaty with the Swedes, Michael regained Novgorod and Pskov. Commerce with England and Holland was encouraged. Foreign officers, engineers, physicians, and artists began to impart the benefits of western technique. By the end of Michael's reign, over 1,000 German families lived at Moscow in a special suburb. Michael's son and successor, Alexei, who came to the throne in 1645 at the age of 16, was likewise an able and progressive ruler. Warned by popular unrest, Alexei from 1645-49 inspired the formulation of a modernized law-code (*Ulozhenie*). His tasks were further complicated by serious uprisings in Pskov and Novgorod, while the reopening of hostilities with Poland was hampered by a cholera epidemic. The consequent decline of trade caused a decrease in the influx of foreign silver, and Alexei was obliged to debase the coinage in order to finance the war. Only after eight years of economic disorders was silver restored to circulation. From 1668-71, the national peace was also threatened along the Don and the Volga by a peasant revolt under Stenka Razin. Alexei was successful, however, in recovering from Poland Smolensk, Kiev, and the Ukraine; from his reign forward, Poland ceased to constitute a serious menace. The period of Alexei Mikhailovich marks a distinct revolution in Muscovite intellectual life. The current of foreign influences which had set in under Boris Godunov and intensified itself in the reign of Michael Romanov now became a dominant factor in the evolution of Russian culture. For the first time, men of western education were prominent in the administration of the state.

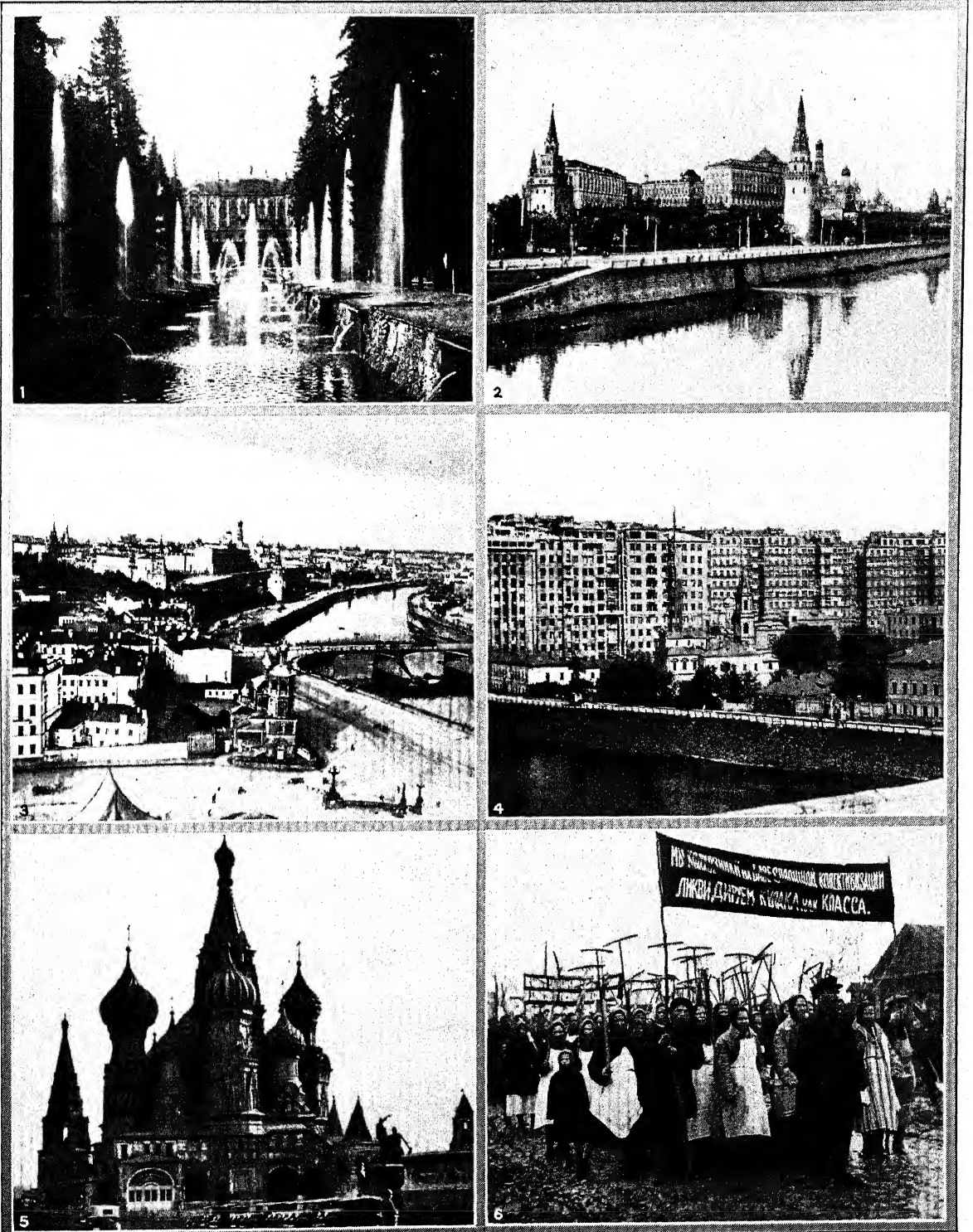
Peter the Great. By his first wife, Alexei had two sons, Theodore and Ivan, and several daughters. His second wife, Natalya Naryshkina, herself brought up under progressive influences, was the mother of Peter the Great, 1672. From his accession in 1676, Theodore was guided in the main by intelligent advisers in the sense of his father's liberal policy. His younger brother was a sickly and mentally inferior youth, so that, on Theodore's untimely death in 1682, the influential relatives of Alexei's second wife desired to pass over Ivan and bring Peter to the throne. Their opponents, backed by the discontented garrison troops in Moscow (*Streltzy*), opposed this step and put through an arrangement whereby Ivan and Peter should be joint Tsars with their sister Sophia as regent during their minority. With his mother, Peter was relegated to an estate near Moscow where he grew up with a degree of personal freedom impossible in the Kremlin. His associations with German officers and immigrants at this period were crucial for his intellectual development. Lacking formal scholastic education, he was well-trained along technical and military lines, though his nervous system was undermined by constant fears of violence from his enemies.

Even after Ivan's death in 1690 Peter at first interested himself very little in administrative matters, which he left in his mother's hands till her death in 1694. Peter spent 1697-98 in Western Europe. Upon his return, he banished his wife to a convent, punished a revolt of the *Streltzy* with unparalleled ferocity, and condemned his sister Sophia, who had inspired it, to become a nun. Having concluded peace with the Turks, he set out in 1700 to obtain an outlet to the Baltic by a war of 21 years' duration against the Swedes. In the battle of Poltava, 1709, Peter defeated Charles XII of Sweden, definitely crushing the Swedish power and then proceeded to the conquest of the Baltic coast and Finland. By these additions, Russia became a European power of the first rank.

In 1703 Peter had founded St. Petersburg (Leningrad) on the swampy islands at the mouth of the Neva, and here, on Nov. 2, 1721, he adopted the title of "Emperor of all the Russias," thus creating the pre-revolutionary Russian Empire. By his military successes against Turks and Persians, Peter secured for himself dominance on the Black and Caspian seas. With his boundaries thus assured, Peter could devote himself to internal reforms of immense scope. Peter's early administrative and financial innovations had been dictated previously by military necessity. Only in the last decade of his reign did he evolve a characteristic system, though without altering the basis of imperial autocracy. While equalizing the privileges of the nobility with the obligations of state service now laid upon them, Peter interested himself with rather less success in city government and the development of an urban middle class. He replaced the old Muscovite governmental apparatus with a Senate, nominated by the Crown, and 10 ministerial departments, known as colleges; the country was divided into provinces, or *gubernii*. Peter replaced the Patriarchate, which had superseded the metropolitanate of Moscow in 1589, by the Holy Synod headed by a layman, thus subjecting the Church to the State. He did little to improve the situation of the peasantry; in fact, his laws tied the serf still more firmly to the soil. His taxation system was onerous, but at his death it left the country without a public debt, despite his huge expenditures for military and construction projects. Foreign manners and education were introduced under compulsion. Despite the inertia and resistance which Peter encountered in executing his projects, his reign doubtless advanced Russia by the equivalent of a century and a half of normal evolution, and his indomitable will continued to actuate the programs of his markedly inferior successors.

Series of Short Reigns. After Peter's death in 1725 the new state carried on by virtue of the bureaucracy which the late Tsar had created, backed by the reorganized army, especially the Guard regiments, which were composed exclusively of gentry. The son of Peter's first marriage, Alexei, had been executed in 1718 for complicity in plots against his

RUSSIA



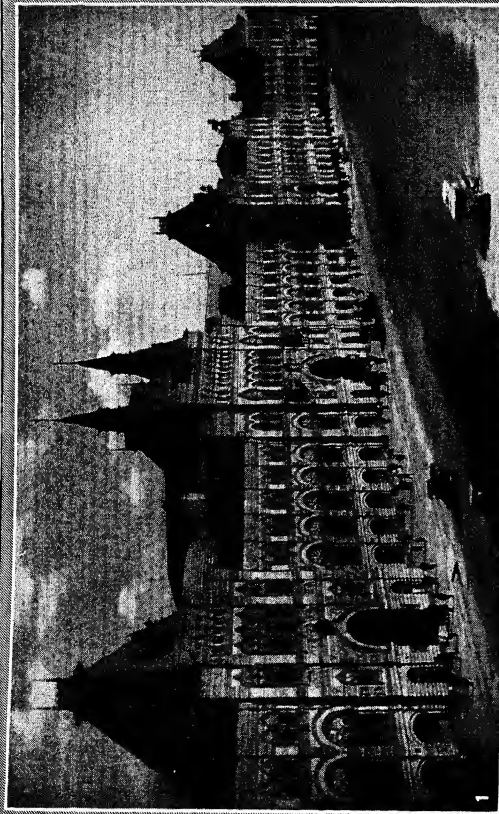
1, 2, 3, COURTESY HAMBURG-AMERICAN LINE; 4, AMTORG TRADING CORP.; 5, 6, SOVIET PHOTO AGENCY PHOTOS

SOVIET RUSSIA TO-DAY

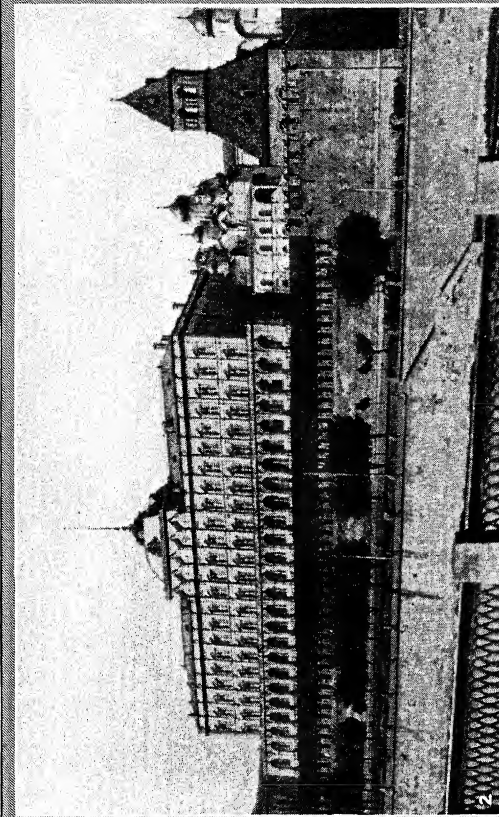
1. Fountains of the palace at Peterhof, near Leningrad. Built by Peter the Great, the palace is now used as a museum. 2. View of the fortress of the Kremlin, from the Moskva River. 3. Moscow, the Kremlin on the left.

4. Government office buildings under construction at Moscow. 5. Church of St. Basil the Blessed, Moscow, now a government museum. 6. Peasants marching to work on one of the great collective farms of the U.S.S.R.

RUSSIA



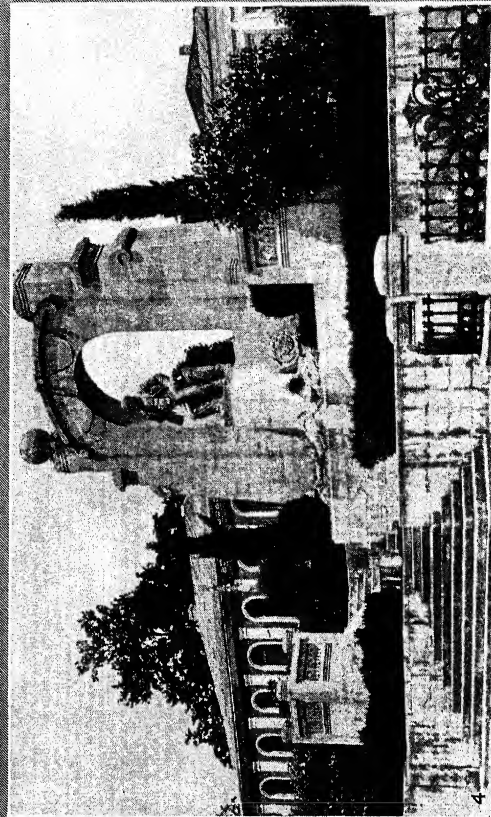
1



2



3



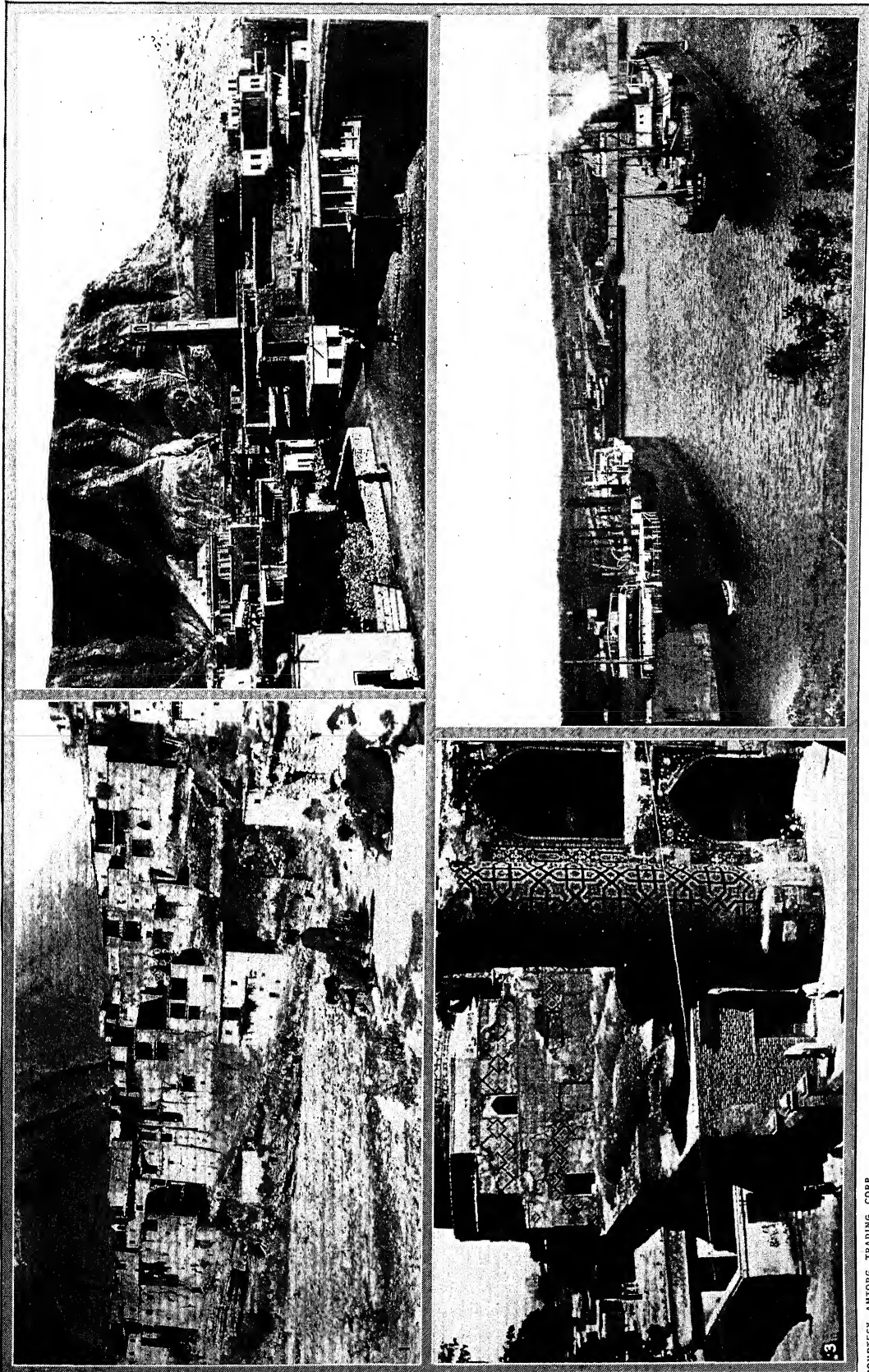
4

1, 3, 4, SOVIET PHOTO AGENCY; 2, COURTESY HAMBURG-AMERICAN LINE

SCENES IN THE SOVIET REPUBLIC

1. The building of the Central Committee of the Union of Socialist Soviet Republics, on Red Square, Moscow. 2. Great Kremlin Palace with the former baptism and marriage church at the right. 3. The Lenin Mausoleum, Moscow, where the embalmed body of the great Soviet leader is on public view. 4. Monument to Lenin by Yosef Nikoladze in Kutais, Georgian S.S.R.

RUSSIA



OLD AND NEW IN THE SOVIET REPUBLICS

1. Village of Usade in Dagestan, Transcaucasia. 2. Cherkop village in the Dagestan Socialist Soviet Republic. 3. Mosque Tilla-Kari in Samarkand, remarkable for the beauty of its enameled tile-work. 4. At a port established by the U.S.S.R.—vessels waiting to be loaded with Siberian lumber at Igarka on the mouth of the Yenisei River, Siberia.

ESTONIA

Area 18,354 sq. m.
Pop. 1,117,000

PRINCIPAL CITIES

(Including Figures from Latest Population Estimates)
Pop.—Thousands
134 Tallinn (Revel)....F 4
72 Tartu.....G 5

FINLAND

Area 149,954 sq. m.
Pop. 3,634,040

PRINCIPAL CITIES

(Including Figures from Latest Population Estimates)
Pop.—Thousands
Abo, see Turku.
241 Helsinki (Helsingfors)....F 4

LATVIA

Area 25,395 sq. m.
Pop. 1,900,050

PRINCIPAL CITIES

(Including Figures from Latest Population Estimates)
Pop.—Thousands
57 Liepaja (Libau)....H 1
378 Riga.....H 3

LITHUANIA

Area 21,683 sq. m.
Pop. 2,392,938

PRINCIPAL CITIES

(Including Figures from Latest Population Estimates)
Pop.—Thousands
110 Kaunas (Kovno)....I 2
38 Klaipeda (Memel)....H 1

UNION OF SOCIALISTIC SOVIET REPUBLICS (Europe)

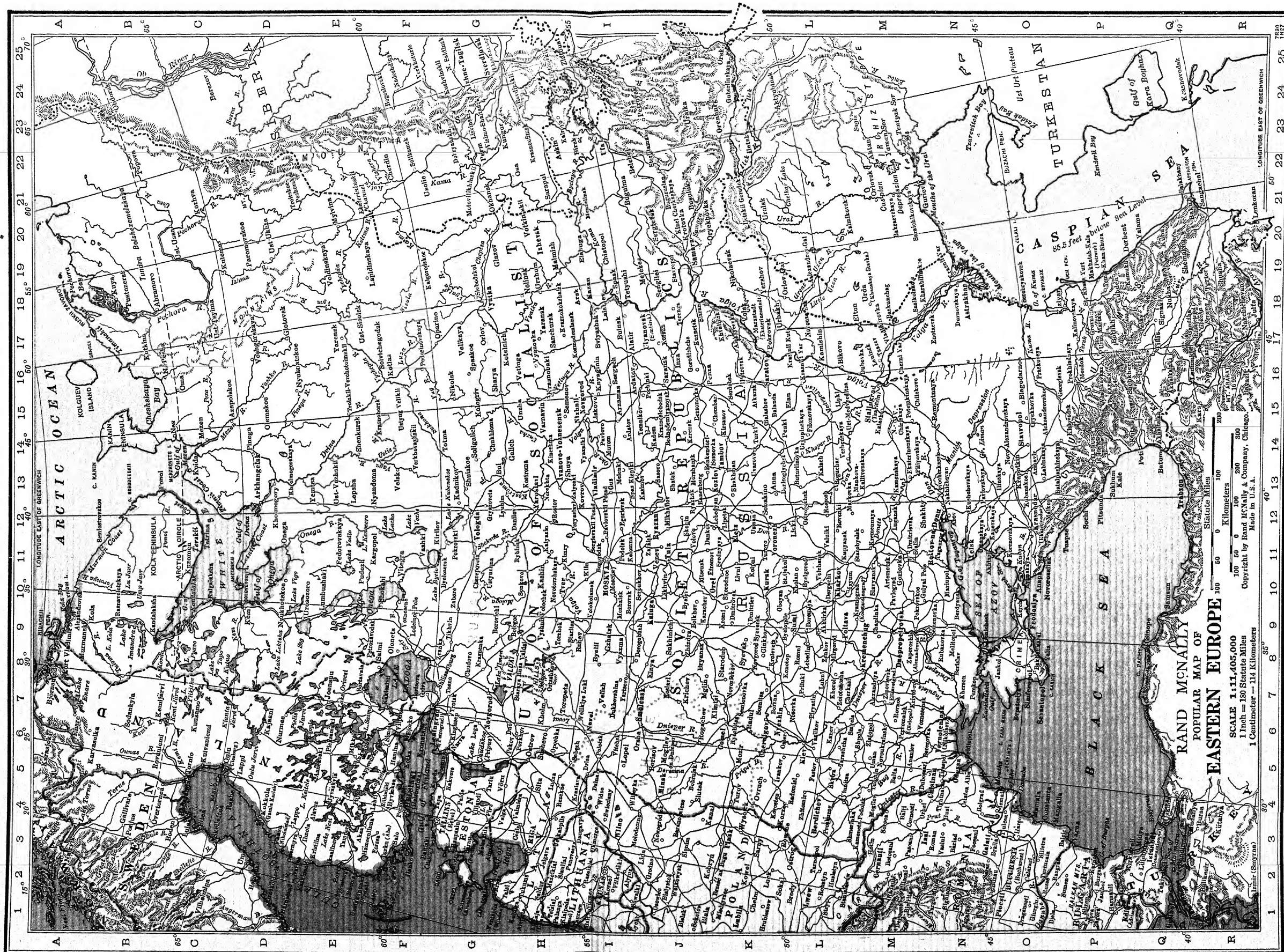
Ar. 1,707,496 sq. m.
Pop. 132,114,545

PRINCIPAL CITIES

(Including Figures from Latest Population Estimates)
Pop.—Thousands
189 Astrakhan
453 Baku.....N 19
188 Dnepropetrovsk (Ekaterinoslav)....M 9
Ekaterinodar, see Krasnodar
120 Ivanovo-Voznesensk
184 Kazan.....I 13
425 Kharkov.....I 10
534 Kiev.....I 6
167 Krasnodar O12
1677 Leningrad F7
137 Minsk.....J 4
2155 Moskva (Moscow)....I 11
198 Nizhni-Novgorod.....I 15
459 Odessa.....N 5
128 Orenburg K 23
Petrograd, see Leningrad
324 Rostov-na-Donu.....N 12
183 Samara.....J 19
222 Saratov.....K 17
156 Stalingrad

293 Tiflis.....Q 17
Tsaritsin, see Stalingrad

158 Tula.....J 11
112 Tver.....H 10
102 Vitebsk.....H 6
123 Voronezh K 12
119 Yaroslavl H 12



father Peter's second wife, Catherine I, originally a washwoman, survived him by only two years. The succession then passed to Alexei's son as Peter II, who died in 1730. The next incumbent was Anna of Kurland, daughter of Peter the Great's half-brother Ivan. Her reign was marked by the tyrannical régime of her minister Biron and his German associates; but Anna's prestige as a Russian princess discouraged open revolt against them. Upon her death in 1740, general resentment broke out. Anna's feeble heirs were removed from the throne, and replaced by Peter the Great's daughter Elizabeth, who eliminated the German favorites responsible for the unpopularity of her immediate precursors. During Elizabeth's reign, owing to her own lethargy and the inexperience of her advisers, Peter's reforms ran largely on their own momentum. A war with Sweden won additional territory in Finland. In European politics, Elizabeth inclined to Austria. She accordingly cooperated in the Seven Years' War against Frederick the Great, 1757-60. The death of Elizabeth, Jan. 5, 1762, halted Russian participation in the war.

Catherine II. The succession now devolved upon the only other living descendant of Peter the Great, namely, upon Peter III, the son of Peter the Great's daughter Anne. Peter had been brought from Denmark to Russia at the age of 14, and three years later, 1745, was married to Princess Sophia-Augusta of Anhalt-Zerbst, subsequently better known as Catherine II (the Great). He disliked Russia and the Russians, and immediately upon his own accession negotiated a hasty peace with Prussia. He alienated both clergy and army, and even threatened to divorce Catherine, who personally commanded considerable political influence as the legal guardian of their infant son Paul. By her tactful behavior, she had won numerous influential friends in military circles. In the summer of 1762, they thus declared Catherine Empress. With her troops she marched on Oranienbaum, a suburb of St. Petersburg where Peter was living. The deposed Tsar was captured and secluded on a country estate where he lost his life in a drunken brawl.

In importance, the reign of Catherine II, 1762-96, at least equals that of Peter I. She reformed the provincial administration, regulated the rights and privileges of the upper and middle classes, won for Russia the northern shore of the Black Sea and the Crimea, gained the Russian-speaking sections of Poland, and annexed Kurland. Her government, considering the age, was liberal and enlightened. The personal culture and broadmindedness of the Empress influenced not only contemporary legislation and politics but also the movement of Russian literature in her day. Catherine unfortunately made little progress toward relieving the situation of the harassed peasantry, whose discontent broke out most menacingly in 1771 in the rebellion headed by Pugachov which was suppressed only with difficulty by Suvorov in 1775. Though Catherine reacted from her husband's predilection for Frederick the Great,

she remained neutral during the balance of the Seven Years' War.

Since Peter the Great, Russian intervention in Poland had become chronic. Catherine thus profited by the anarchy following the death of Augustus III in 1773 to extend her influence and possessions at the expense of the Poles. In conjunction with Austria and Prussia, Catherine by force of arms effected a cut in Polish territory by which the White Russian district came under Russian sovereignty (first partition of Poland). Successful operations on land and sea against the Turks, 1768-74, culminated in the treaty of Kuchuk-Kainardji, which assured Russian possession of the mouths of Bug, Dnieper and Don. In 1783 the Khanate of the Crimea also fell into Russian hands. A revolt in Poland, 1791, provoked joint repressive measures by Prussia and Russia, and led to the second division of the Republic by which Russia secured Volhynia, Podolia and the Minsk district. Polish resistance was continued in 1794 under the leadership of Kosciuszko, and upon the defeat of his partisans, Russia, Prussia and Austria, shared among them what remained of Poland, thus eliminating the Republic from the scene as an independent state. The reign of Catherine successfully completed the expansion of Russia westward, save for the Duchy of Warsaw, acquired after the defeat of Napoleon.

Catherine entertained little affection for Prince Paul, her son by Peter III, but devoted unusual care to the liberal education of Paul's son Alexander, born in 1777. Upon Paul's accession to the throne at the age of 42, he was already broken, if not definitely deranged, by the neglect he suffered during his mother's reign. Like his father, Paul devoted himself largely to useless military reforms, though he deserves credit for having at last established by decree the formal principles of succession to the Russian throne. His attitude toward all liberal movements was negative; he restricted foreign travel, attendance at foreign universities, and importation of foreign books. Though Paul's intentions were pacific, he was drawn into war by the threat of French revolutionary conquests. In 1798 he therefore joined the Coalition against France, and in 1799-1800 Suvorov conducted his remarkable campaigns in Italy and Switzerland. A break with England then paved the way for peace with Napoleon. Paul's domestic policy won him nothing but enemies. On Mar. 22, 1801, a band of conspirators assassinated him, and offered the throne to his eldest son, Alexander I.

Alexander I. Alexander had been early imbued with liberal principles through Laharpe, his Swiss tutor, and there was a pronounced mystical side to his nature which dominated his later years. He immediately declared for the liberal policies of his grandmother, amnestied political prisoners and exiles, and placed in authority officials trained under Catherine's régime. Alexander restored the Senate to its position of chief administrative organ which it had lost under Catherine the Great. He transformed the antiquated departmental colleges into regular minis-

tries with responsible ministers as their chiefs, who met like a cabinet or committee of ministers, with the Tsar as chairman. Beside thus modernizing the administration, Alexander devoted much attention to the serfs, providing more generous conditions for their liberation. For a time, under the beneficent influence of M. M. Speranski, Alexander contemplated a widespread social reform, including emancipation of the serfs, but this project was never realized, particularly as the liberal and Francophile views of Speranski were rendered unpopular by the rising menace of Napoleonic conquest.

Disturbed by French expansion in Italy and Germany, Alexander formed a combination against France in conjunction with England and Austria. Hostilities began in 1805, but the coalition could not prevent Napoleon's capture of Vienna, and the Russo-Austrian forces were beaten at Austerlitz. In 1807 Alexander met Napoleon at Tilsit and negotiated a peace confirmed the next year at Erfurt. Campaigns of 1808-09 against Sweden won the rest of Finland for the Russian colors, and a peace with Turkey in 1812 gave Bessarabia to the Tsar. Alexander's friendship with Napoleon was not popular at home, nor was his acceptance of the continental system economically advantageous for Russia. Napoleon's arbitrary treatment of German principalities also irritated Alexander, who was in general unwilling to reduce himself to the level of a pawn in Napoleon's ambitious designs. Alexander thus began military preparations in 1812, and awaited Napoleon's attack. Napoleon allowed himself to be drawn far into the interior by the strategic Russian retreat, and an unsuccessful Russian resistance before Moscow at Borodino opened the way to the metropolis, which the Russians evacuated and set on fire Sept. 14, 1812. During the next winter, the painful French retreat from Moscow, with its heavy losses, was a crucial blow to Napoleon's prestige and strength. Pushing his advantage, Alexander formed a new coalition against Napoleon, who met a crushing defeat by the Allies at Leipzig. The Allies then followed Napoleon into France; Paris fell on March 31, 1814, and the Emperor abdicated. In the following autumn the Allies assembled in the Congress of Vienna for the reconstruction of Europe. By the spring they had progressed well on their way, when disputes occurred and Napoleon returned from Elba in March. Immediately the Allies formed a new coalition and defeated him at Waterloo. By the subsequent formation of the Holy Alliance, 1815, Alexander aimed at the pacification of Europe, though he succeeded only in assuring the dominance of conservatism for the next three decades.

During the last years of his reign, Alexander's mystical tendencies gained the upper hand. He abandoned the administration to officials of whom some were hopelessly reactionary. In particular, the tyranny of Arakcheyev as prime minister provoked deep discontent among the liberal intelligentsia which was being created under the influence of closer contacts

with western philosophy and ideas. The desire for radical reforms in the direction of a constitutional monarchy was widespread among army officers, and manifested itself in an extensive conspiracy at the moment of Alexander's death in 1825.

Nicholas I. Since Alexander was childless, the succession rightly belonged to his next younger brother Constantine. The latter had resigned his rights to the throne in 1823 upon his marriage to a commoner, and Alexander expected his second brother Nicholas to succeed. The liberal conspirators tried in vain to profit by the throne's moment of weakness at the change of incumbents; but owing to lack of organization, the movement failed in St. Petersburg and most of the leaders were caught. This conspiracy, known as the Decembrist movement, was the prelude to all protests of the 19th-century intelligentsia against the abuses of autocracy. Warned by the Decembrist conspiracy, Nicholas mistrusted the nobility, and therefore endeavored to centralize the administration and to govern through a strong bureaucracy not necessarily of aristocratic origin. He secured the co-operation of Alexander's former aide, M. M. Speranski, in the formulation of a modernized law code, while Kankrin, Nicholas's Minister of Finance, restored some semblance of order in the treasury. The Tsar concerned himself somewhat with improving the lot of the peasants, but was not yet ready to approach the emancipation of the serfs. While a considerable number of new schools were opened, higher institutions were critically supervised in order to prevent the spread of any ideas which the Government might consider subversive. The censure of books, periodicals and newspapers was vigorous.

Nicholas I cooperated with France and England in their protest against Turkish cruelty in Greece. A Russian fleet thus took part in the battle of Navarion, 1827, and the next year, Russia declared war on Turkey. Russian troops captured Adrianople, while the Tsar's columns pushed into Armenia. The subsequent peace won the autonomy of Moldavia, Wallachia and Serbia under Russian protectorate and opened the Dardanelles to international shipping. A revolt in Poland, 1830-31, was put down with great severity by Paskevich. The efforts of the Porte to profit by the rivalries among the Powers for influence in Turkey again resulted in 1853 in a Russo-Turkish war. England, France and Sardinia entered on the side of Turkey, and in Sept. 1854 the Crimean campaign began. While not a success for the allies, the Crimean War revealed the fundamental weaknesses of the Russian state and was a bitter blow to Nicholas himself, who died suddenly on Mar. 2, 1855.

Alexander II. Upon succeeding his father, Alexander II brought the war to a close, and thus cleared the way for domestic reforms. He was the first Tsar to have enjoyed a thorough administrative training before his accession. His initial concern was the abolition of serfdom. After several years of preliminary studies, this revolutionary measure was promul-

gated on Mar. 3, 1861. By creating a new class of free citizens numbering some 25,000,000, it demanded a thorough revamping of the local administrative system. Alexander therefore went on to create rural organs of self-government in local boards, known as *zemstvos*, and also to lay the foundations for autonomous urban administration. Parallel with these reforms, the judicial system was completely revised. Order was restored to the imperial finances by introduction of a unified budget. Private initiative in railroad construction was encouraged, industrial development was accelerated, and foreign trade stimulated. The transformation of Russia from a patriarchal state to a modern national economic state proceeded rapidly. Freed from certain burdens of censorship, public opinion was more frankly expressed; political literature took on new life. The nobility definitely lost its dominant position, and the democratization of society progressed.

Russian expansion in Central Asia and the Caucasus continued. The revolt of the Balkan Slavs against Turkish misrule inspired Russian intervention in 1877, and after an obstinate winter campaign, Russian troops were within striking distance of Constantinople. At this juncture the Powers intervened. At the Congress of Berlin, 1878, Russia was deprived of much she had gained by the war, which produced marked disillusion both in Russia and among the Balkan nations. Unfortunately, none of Alexander's reforms had in any way modified the rights of the autocracy or tended to admit popular representatives to an effective share in governmental functions. The widespread desire for a constitutional régime was thus by no means satisfied, and the activities of radical elements were stimulated accordingly. A terrorist attempt was made on the Emperor's life in 1866, and as the earlier reforms functioned badly or were hamstrung by the bureaucracy, revolutionary sentiment became intensified and infected the entire younger intelligentsia. The roots of much modern Bolshevik theory are to be found in the ideas of young radicals of this period. After the Balkan War, the current of unrest was aggravated. The Tsar was sincerely disposed to make concessions to the more moderate liberals. He had just called progressive statesmen to his aid when he fell victim to a terrorist bomb on Mar. 13, 1881.

Alexander III. The assassination of Alexander II definitely discredited liberalism in the eyes of Russian official circles. The result was a period of reaction which, though briefly interrupted by the revolution of 1905 and the ensuing concessions, came to an end only with the final overthrow of the Empire in 1917. The reign of Alexander III was thus characterized by chronic repression aimed at maintaining the strength of autocracy. Russification of subject nations was ruthlessly pursued; religious intolerance was rampant. Russian foreign relations were marked by estrangement from Germany and attachment to France, while French capital participated generously in financing Russian industrial development and in floating state

loans. After 1878 a decline of Russian influence in the Balkans was compensated by increased activity in Eastern Siberia.

Nicholas II. The accession of Nicholas II in 1894 produced no relief from the depressing factors in Russian national life. The economic strength of the Empire was temporarily enhanced by the reforms of Count Witte, who served as Finance Minister for 11 years from 1892, put the country securely on a gold basis, and organized the construction of the Trans-Siberian Railroad. The development of an industrial proletariat favored the spread of Marxian socialism in revolutionary circles, and by 1900 the extremist element, later celebrated as Bolsheviks, was already formed. Liberalism centered among the *zemstvos*, members of which worked zealously for the betterment of the peasantry. Nicholas II lacked the personal authority possessed by his father and, in still larger degree, by Alexander II. The real power passed from the throne to the reactionary bureaucracy, while the throne gradually lost all national respect and loyalty. An ill-timed and increasingly aggressive policy in the Far East from 1895 forward speedily brought Russia into collision with the Japanese. A conflict over Manchuria thus precipitated in 1904 the Russo-Japanese War, which resulted in a crushing military defeat for Russia and in the destruction of the Russian navy, revealing at the same time the weakness, corruption and decay inherent in the autocracy. Discontent spread to all classes of the population, and culminated in riots, peasant uprisings, and eventually in general strikes.

Driven to the wall, the Tsar by his manifesto of Oct. 1905 conceded the establishment of a national parliament, the Duma. Outbreaks of open rebellion continued into 1906, but, in consequence of defective organization, were gradually repressed. The Duma never operated with appreciable efficiency, and was eventually so restricted in function as to constitute little more than a forum for political debate. As the bureaucracy regained strength, it resumed the reactionary practices in vogue since 1881. The Government continued to seek prestige in questions of foreign policy, and through its effort to obtain a dominant influence in the Balkans, not only aroused the hostility of Austria-Hungary but also saddled itself with the dangerous duty of protecting Serbia against Austrian aggression in 1914. Imperial Russia was morally, administratively, and financially incompetent to wage a major war of modern proportions. It was therefore only a question of time when the whole structure of autocracy would break down under the strain. The Liberal elements of the population gave the Government their patriotic support until 1916. When it became clear that the autocracy could neither prosecute the war effectively nor reconcile itself to democratic concessions in the national interest, the Duma in Mar. 1917 finally took matters into its own hands and forced the abdication of Nicholas II.

Russian Revolution. Though animated by noble intentions, the little group of middle-class Lib-

erals who inherited the sovereignty were out of touch with the peasant masses and the industrial proletariat and unable to organize their victory. Their insistence on continuing the war was not understood by the lower classes, who had no interest in the abstruse international questions behind it. Returning to Russia through German connivance, Lenin and the other Bolshevik leaders thus had little difficulty in galvanizing peasants, workers and soldiers through their promises of peace and land. One after another the Radicals forced the cabinet members to resign till the Socialist Kerensky became virtual dictator in July. But this was only another step to the overthrow of the provisional government and the seizure of power by the Bolsheviks in Nov. 1917. The latter concluded an armistice with the Central Powers, and set out to realize their ideal of a communist state. Until 1920 the Bolshevik Government was obliged to fight a variety of so-called White armies opposed to the communist regime. Having no real support from the masses, these anti-Bolshevik units gradually faded from the scene, leaving Russia in the control of a resolute doctrinaire minority who had won their dominant position largely because they were the only party with a definite program and sufficient internal party discipline to permit its ruthless enforcement. The history of Soviet Russia (see UNION OF SOCIALIST SOVIET REPUBLICS) since 1920 covers a period of economic recovery under centralized Government control and exhibits the efforts of the Bolshevik leaders both to propagate revolution abroad and to win recognition as the *de jure* heirs of the defunct autocracy.

S. H. C.

BIBLIOGRAPHY.—V. O. Klyuchevski, *A History of Russia*, 4 vols., 1911; Sir Bernard Pares, *A History of Russia*, 1926; G. V. Vernadski, *A History of Russia*, 1930; M. N. Pokrovski, *History of Russia from the Earliest Times to the Rise of Commercial Capitalism*, 1931.

RUSSIAN, WHITE, an East SLAVIC language forming the transition between RUSSIAN and UKRAINIAN and spoken by 4,700,000 persons in White Russia, with Minsk as the center, by 772,000 in other parts of the U.S.S.R., and by 1,060,000 in northeastern Poland. It was the official language of the Grand Dukes of Lithuania, but was replaced by POLISH in the Lithuanian Chancellery in the 16th century. A White Russian translation of the Bible appeared in 1519, but poetry was published only in the 19th century.

BIBLIOGRAPHY.—E. F. Karskij, *Belorussiy*, 2 vols., 1903-12.

RUSSIAN BANK, a two-handed card game, in which each player uses a full deck. The players shuffle and cut for each other. Each deals 12 cards face downward at his right; this pile is called the stock. Then the tableau is made by each player dealing four cards face upward in a line between himself and his opponent, leaving space between for the foundations. The remaining cards form the hand and are faced downward at the left. The player having cut the lowest begins, if possible, by moving any aces from the tableau into the foundation space. Then, all cards in sequence and suit with the aces must be

moved on them, since it is the main object of the game to build up each suit from ace to king. At all times it is compulsory to play on the foundations when possible. If neglected, the opponent may knock and begin his play immediately. After completing foundation moves, the tableau cards can be built outward with cards of alternating color in descending sequences. Stock cards can be used only to fill spaces created in the tableau by the moving of cards. When all the vacant spaces have been filled and no more plays are possible from the stock, the top card is left facing upward on the stock pile.

Next, cards of the hand are turned. These are playable on the foundations and tableau, one at a time, but may not be used to fill spaces. The first unplayable card of the hand starts the discard pile at the left which remains face upward on the table. The second player may now start and continue in like manner. A player may also put a card or cards on his opponent's stock and discard pile, either from the tableau or his own cards, in descending or ascending sequences. Sometimes further moves from the stock can be made after cards from the hand are released. When the stock is exhausted, playing continues from the hand, and when the last card of the hand is put on the discard pile, it is turned over face downward, becoming the hand again. Playable cards cannot be withheld in order to block the game. The first to dispose of all his cards is the winner. He gets 30 points for the game, two points for each card in his opponent's stock, and one point for cards remaining in his opponent's hand and discard pile.

RUSSIAN DRAMA. Although the Russian theater had its roots in the imperial court of the late 16th and early 17th centuries, Russian drama as an independent national cultural growth was born with Denis Fonvizin (1744-92) and his plays, *The Brigadier*, 1766, and *The Minor*, 1782. Nearly half a century passed, however, before the art of playwrighting became securely and indigenously established with the completion by ALEXANDER GRIBOYEDOFF (1795-1829) of his single masterpiece, *Gore of Uma* or "The Sorrows of the Spirit," 1823. Thenceforward, Russian drama, like all of the other Russian arts, unfolded under the nationalistic stimulus of the Decembrist Revolution, 1825. In that year, ALEXANDER PUSHKIN (1799-1837) diverted his poetic genius to the stage in *Boris Godunoff*, his single original major dramatic work, although his *Yeugeny Onyegin*, 1832, and other poems have been turned to operatic and dramatic uses by Tchaikovsky and others. Between this classic and heroic period of Russian drama and the more realistic epoch which held sway through the middle of the 19th century, the bridge is NIKOLAI GOGOL (1809-52), whose *Revizor* or "The Inspector General," 1836, and *Marriage*, 1836-48, still hold the stage in Russia and outside as trenchant social criticisms just within the rigid rulings of the censor.

Middle Period. ALEXANDER OSTROVSKY (1823-86) almost completely dominated the middle or realistic period of Russian drama. Energized by the freeing

of the serfs in 1861 and other liberal policies of Alexander II, the bourgeois merchant class of Moscow gave color to Russian life and provocative material to Ostrovsky's pen in nearly 60 plays of which those tested by time include *Poverty Is No Vice*, 1854, *The Thunderstorm*, 1860, *Enough Stupidity in Every Wise Man*, 1868, *The Warm Heart*, 1869, *The Forest*, 1871, *Wolves and Sheep*, 1875, *Truth Is Good But Luck Is Better*, 1875, and *The Girl Without a Dowry*, 1878. IVAN TURGENIEV (1818-83) tended to romanticize his realism in his single full-length play, *A Month in the Country*, 1855, but Alexander Sukhovo-Kobulin (1817-1903) wrote with the homely point of view of the age in *The Wedding of Kretchinsky*, 1855, *The Affair*, 1869, and *The Death of Tarelkin*, 1869, as did also Mikhail Saltyukoff-Shchedrin (1826-89) in his best play, *The Death of Pazukhin*, 1857, and others. Only Alexei Tolstoy (1817-75) ran counter to the age in reviving the classic heroic and poetic formula for his historic trilogy, *The Death of Ivan the Terrible*, 1866, *Tsar Fyodor Ivanovitch*, 1868, and *Tsar Boris*, 1870.

Period of Transition. A period of transition ensued, with the salt gone from the satiric realism of the mid-century, owing perhaps to the disillusionment of the latter years of the reign of Alexander II and the deep reaction of his successors. The youthful vigor and enthusiasm of LEO TOLSTOY (1828-1910), which turned inward to breed anger, pity, scorn and finally resignation, sought outlet in drama for the first time when Tolstoy was 58 in *The Power of Darkness*, 1886. *The Fruits of Enlightenment*, 1889, followed. These and three dramas which came to light posthumously, *The Living Corpse*, *The Light That Shines in Darkness* and *The Source of All Evil*, stand out like oases in an arid waste. Minor but mentionable talents of this transition period include two playwright-regisseurs, Vladimir Neminovitch-Dantchenko, co-founder with CONSTANTIN STANISLAVSKY (1863-) of the Moscow Art Theater, with *The Last Will*, 1888, *The New Affair*, 1890, *Gold*, 1895, and *The Value of Life*, 1896; and Alexander Sumbatoff (1857-1927), director of the Small State Theatre, Moscow, with *The Lightning Rod*, 1878, *Rustling Leaves*, 1881, *The Husband of a Celebrity*, 1885, *Chains*, 1889, and others.

Modern Drama. ANTON CHEKHOV (1860-1904) heralded the birth of modern Russian drama, a period characterized simultaneously by ruthless realistic social probing, mystical inquiry and sweeping technical innovations. Neither Chekhov nor the dawn of a new age were recognized at once. His *Ivanoff*, 1887, *The Wood Demon*, 1889, and *The Sea Gull*, 1896, all failed or were ignored until the Moscow Art Theatre rescued the latter in 1898 and encouraged Chekhov to go on to *Uncle Vanya*, 1899 (rewritten from *The Wood Demon*), *The Three Sisters*, 1901, and *The Cherry Orchard*, 1903. Chekhov and the Moscow Art Theatre in turn induced MAXIM GORKY (1869-) to write *Smug Citizens*, 1900, *The Lower Depths*, 1902, and *Children of the Sun*, 1904. The times themselves, abetted by the Moscow Art Theatre, inspired the gloomy and tumultuous LEONID ANDREYEV (1871-

1919) to an output of plays of which the following are most likely to be remembered: *Savva*, 1906, *The Life of Man*, 1906, *King Hunger*, 1907, *The Days of Our Life*, 1908, *The Black Maskers*, 1908, *Anathema*, 1909, *The Waltz of the Dogs*, 1914, and *He Who Gets Slapped*, 1915.

Trailing far behind Chekhov, Gorky and Andreyev in the modern period, but in their way significant are FYODOR SOLOGUB (1863-1927), with *Night Dances*, 1908, *Vanka the Butler and Page Jean*, 1909, and *Hostages of Life*, 1916; MIKHAIL ARTZYBASHEF (1878-1927), with *Jealousy*, 1913, *Enemies*, 1913, and *War*, 1914; DMITRY MEREZHKOVSKY (1865-), with *Paul I*, 1908, and *There Will Be Joy*, 1916; Ossip Dymoff (1878-), with *Nyu*, 1907; and Sholom Ash (1881-), with *The God of Vengeance*, 1907.

Contemporary Russian drama, as distinguished from the generally modern, is largely inconclusive and inconspicuous. Seeds for a revolutionary drama were planted before the Soviet régime by ALEXANDER BLOK (1880-1921), with *The Little Booth*, 1906, *The Unknown Woman*, 1907, and *The Rose and the Cross*, 1912; and by Nikolai Yevreinoff (1879-), with *The Foundation of Happiness*, 1902, *Such a Woman*, 1908, *Gay Death*, 1909, *The Representation of Love*, 1910, *The Theatre of the Soul*, 1912, and *The Chief Thing*, 1921.

The political, social and esthetic compulsion to convert the theater and the drama into weapons of propaganda, however, has resulted thus far in an almost complete dramatic sterility under the Soviet. Not in a theatrical sterility, on the contrary; for, if the contemporary Russian dramatist has dwindled to a pigmy and a puppet rigged to politics and propaganda, the theater has spread like the rumor of war through the Russian land. The cities have doubled and trebled the number of their stages; even the villages have their improvised playhouses. The Moscow Art Theatre and Vsevolod Meyerhold had set and maintained for years standards of performance and theatric interpretation at the extreme esthetic poles—standards which have been avidly and pugnaciously emulated; while the great body of Russian drama, classic and modern, was at ready hand for these new stages. It is probably only a question of time when these new stages will incite to creation a new generation of playwrights who will be no more hampered by the restrictions of the Soviet than were Pushkin, Gogol, Ostrovsky, Tolstoy, Chekhov and Gorky by the strictures of the czars. O. M. S.

BIBLIOGRAPHY.—H. Carter, *The New Spirit in Drama and Art*, 1912; Bakshy, *The Path of the Modern Russian Stage*, 1916, O. M. Sayler, *The Russian Theatre*, 1922, *Inside the Moscow Art Theatre*, 1925; Wiener, *The Russian Theatre*, 1922.

RUSSIAN EDUCATION. The history of organized formal education in prerevolutionary Russia began with the period of the introduction and expansion of Christian influence and terminated with the fall of the last of the Romanoffs in 1917. Two main tendencies are to be noted during the first part of this period, from the 10th century, the dominant influence

was ecclesiastic and feudal; in the second part, beginning with the rise of the Moscovite power, nationalism became a powerful determining factor in education and, with Peter the Great, became of greatest importance though it continued till the Revolution to make use of the ecclesiastical system for its own ends.

Of the earlier period it must be said that education was narrow in character; was limited to but a few, the clergy and the nobility; was carried on mostly by monasteries and a few private teachers, and served chiefly as a means of preparing leaders in ecclesiastical circles. A few convents for girls, one of them established by the daughter of the Prince of Polotske, in the 12th century, taught them religion, reading, writing, embroidery and good manners, that they might be "pure and modest, keep the fasts, be silent while eating and drinking and when in the presence of elders, and always dutiful and humble." Discipline followed the patriarchal precepts of the Old Testament. The prevailing educational ideals of these early days may be found in the *Domostroi*, *The Book of Good Manners and The Instructions of Vladimir Monomach*. The *Domostroi* advises, "Punish thy son whilst he is young that he may take care of thee when thou art old; fear not to chastise a child; a rod will not hurt him, he becomes all the stronger for it." Through the 13th, 14th, 15th and 16th centuries Russia passed, untouched by the influences of the Renaissance, Reformation and scientific movements; but some new interest in education is evidenced by the creation of a number of new classical schools in the second half of the 17th century.

Western Influence. Under Peter's leadership Russia began to look westward, and was brought under the influence of western rationalism and scientific realism. In attempting to graft western technique upon religious, mystical Russia, Peter appears to be the first of the Bolsheviks. Their ideas are his, plus dogmatic Marxism and Leninism. Both machinery and specialists were imported, and Peter began to dream of transforming Russia by means of education, a dream common in Europe at that day. The first a naval school, was opened in 1701, a Marine Academy in 1715, and then a school for artillery and another for engineers. These aimed at higher technical education; but Peter hoped to advance general education as well, and in 1714 the Code provided for a system of cyphering schools for youths between 10 and 15. In 1715 the Code was made to apply to "young children of every rank"; but this democratic policy was not destined to succeed. Only 20 or 30 of such cyphering schools were actually established. The bishops' schools, 1721, were more successful. The opening of an Academy of Science, a university and a gymnasium and other efforts to promote higher and secondary schools testify to Peter's serious educational intentions. Though followed by a period of reaction and a neo-feudalistic tendency, the reign of Peter was of greatest educational consequence.

Catherine, under the influence of western rational-

ism, sought again, in the latter part of the 18th century, to push education forward. A school for noble girls, Smolny Institute, was established in 1764, and one for girls of all classes except serfs, the Novo-Devichy Nunnery, in 1765. Later a new system of schools for both boys and girls, modeled by Yankovitch upon those of Austria, was provided for by the regulations of 1786. To these a considerable number of peasant and serf children were admitted. A teacher training seminary was established in 1783.

Class Distinctions. The 19th and 20th centuries were marked by reaction in high places, though a brilliant galaxy of men appeared who advocated far-reaching reforms in education. Such were Belinsky (1811-48), Pirogoff (1810-81), Herzen (1812-70), Oushinsky (1824-70), Tolstoy (1828-1910), Dobroliuboff (1836-61) and Pisareff (1839-66). Most significant was Tolstoy who, by his writing and the educational experiment at Yasnaia Poliana, had an influence on such educational leaders as Krupskaya, Shatsky and others who stand in the forefront of Soviet education. On the practice of the day, however, their influence was ineffective. Education continued to be along class lines. The studies of the lower schools were limited, and discipline was severe. The Code of 1804 recapitulated and modified somewhat the one adopted in 1786, providing for parish schools, district schools, gymnasia and universities. Though these were theoretically free from class distinctions, restrictions were introduced which effectually kept lower class children out of higher institutions as a general rule.

The Decembrist revolt marked the strengthening of reactionary tendencies which are clearly evident in the educational provisions of the Statute of 1828. Changes of a minor nature were made by laws of 1852, 1864 and 1871-72; but the support of the autocracy, nationalism and orthodoxy continued to be the purpose of the schools. Most reactionary was the influence of Dmitri Tolstoy, 1866, and Pobiedonostseff, procurator of the Holy Synod after 1880. Education, excepting the most elementary kind, was considered dangerous for the masses; but for the upper classes excellent secondary and university education of classical and scientific sort was provided. Even in the university, however, as Magnitsky said, 1819, the purpose was to educate "faithful sons of the orthodox church, loyal subjects of the Tsar"; and Shiskoff asserted that to teach "the entire people or a disproportionate number of them to read and write would do more harm than good," and that "to instruct a farmer's son in rhetoric would be to make him a bad and worthless if not a positively dangerous citizen." Fees were sometimes raised to keep out the lower classes. Minor nationalities, too, felt the strength of the reactionary tendency and the policy of Russification which was harshest in its dealing with Jews, Poles, other nationalities and certain sectarian groups such as Dukobors, Tolstoyans, Stundists, etc. As late as 1907, teachers' seminary regulations declared: "Your chief duty is to instill religion and inspire your pupils with a love for at-

tendence on God's worship." Teachers, students and university professors were frequently spied upon and dismissed. It is small wonder that the reformist movements, which sent idealistic folk among the peasants and workers for their education and betterment, were translated into revolutionary ones by the coercion and restrictions of police and spy systems with which the Tsar's government faced measures of orderly, evolutionary progress. Many concluded, correctly or incorrectly, that the "only course by which the existing order of things might be changed was a course of violence."

Most hopeful of the events of the last half of the 19th century was the creation of *zemstvos* or county councils, in 1864, which frequently became agencies of better education, especially after 1890. But, if some were progressive because of local leadership, this was by no means a general rule. Moreover, the *zemstvos* were distinctly limited in what they might do; they were subject to censorship, and the number participating in their meetings frequently small. Nevertheless, with the turn of the century, the educational situation improved. Besides the ecclesiastical and *zemstvo* schools, Ministerial schools, directly under the Ministry of Education, were added after 1898. Though, after 1905, efforts of the First and Second Dumas were unavailing to create a universal system of education, educational facilities and the budget increased greatly in the last few years of the Romanoffs: from 5,784,672 Rs., in 1903, to over 72,000,000, in 1916. In 1911, there were 100,295 elementary schools, 47 per cent of which were Ministerial, 51 per cent Synodal and 2 per cent miscellaneous. Ministerial schools increased 32 per cent between 1911 and 1915. These were the most satisfying educational phenomena under the tottering regime of the Romanoffs; but it was too late to strengthen by education an autocracy already suffering decay from several sources.

The Soviet System. Viewed from one angle, education in the Soviet Union appears as a complete innovation. Looked at historically, this conception is at once seen to be unsound. Soviet educators cherish the vision of "new men" and a "new society"; they believe, as firmly as the idealists of the 19th century, that the new man and the new society can be produced by a new education. The dreams of the idealists have been greatly modified, naturally: the new man must now be a Communist, the new society a collective one; and the idea of "free education," proposed by Tolstoy, is of course anathema to them. What, specifically, are the dominant traits of the "new man," the Communist citizen, to be? It is an easily observed fact that the lives of people of every society are controlled by relatively few central ideas. The new citizen of the Soviet Union either is dominated, or is to be dominated, by 12. This analysis of him is based upon observation of his daily life and the processes of his formal education. The number might be elaborated by a detailed analysis, but the central characteristics remain the same. The new citizen believes in, and can justify by Marxian dialectic, the dictator-

ship of the Communist Party, or as is generally said, the dictatorship of the proletariat. He is militant in his defense and advocacy of it. He must be an activist. Though it seems a paradox at first glance, he is to be class-conscious; yet his is to become, at the same time, a classless mind. He believes in universal labor, holds the laborer in high regard, and the exploiter in greatest contempt. His mind must be secular and atheistic, i.e., dominated by science, political, collectivistic, non-nationalistic, and positively international. It must be healthy in the physical sense, a sound mind in a sound body. It is to be a sexless mind, i.e., without sex prejudices, recognizing no preference based upon sex. He who possesses these is the "new man."

Educational institutions of the U.S.S.R. may be grouped into four classes: (1) those forming the general school system; (2) those for the political education of adults; (3) political organization of children and youths, Octabrists, Pioneers and Komsomols; and (4) extra-scholastic mass agencies such as clubs; libraries; "red corners," or Lenin shrines; reading huts; radio; movies; the press; the stage; the Red Army; the fleet; the factory, and the collective farms. Reorganized life in factory and collective farm, it is recognized, must of necessity be the best of teachers of the new ideology.

Control of Education. Education is completely controlled through the state apparatus, back of which stands the Communist Party, which is the real government of the Union. The Church is separated from the State; and schools, from the Church. Only after 18 years of age may youth receive formal religious instruction in groups. Education in public schools is strictly secular, scientific and atheistic. A few seminaries exist for training preachers and priests, entrance being permitted at 18. As yet education is neither universal nor compulsory, even on the elementary level, though this has been the objective for many years; its attainment, however, has been constantly postponed, and is now set for 1932-33. In certain cities, indeed, elementary education is already universal. Since 1930 the policy has been modified to include declassed elements in elementary schools, e.g., *kulaks*, since it is recognized as important that the children of these classes be properly filled with collectivist ideals. Beyond the elementary and, especially, beyond the Labor school, it is almost as hard for son or daughter of declassed elements to pass as for a camel to go through a needle's eye. Men in higher professions, it is hoped, may be recruited from proletarian or peasant stock.

Administration of schools in each of the constituent republics is handled by a Commissariat of Education with appropriate divisions for the several branches of the educational task. Despite the free use of the mother tongue in the schools of the different republics, they are more remarkable for uniformity than for diversity. The unifying element is, of course, the leadership, the control, the ideology of the Communist Party which transcends all national and racial

lines. The budget for education is derived from state, local and other sources. In 1928-29, the total budget amounted to 1,279,000,000 Rs., a little over half of which came from local sources, less than a third from state and the remainder from other sources. The budget, though seemingly liberal, does not extend to liberal salaries; elementary teachers receive about 50 Rs., and secondary about 70 Rs. a month. There are 815,000 educational workers in the Soviet Union.

School System. The school system is threefold, comprising institutions (1) for general social education, (2) for professional training and (3) for political education. Between one and three the most fortunate children of employed parents may be provided for in nurseries connected with the industry where their mothers are employed, and under direction of Boards of Health. Kindergartens, hearths, playgrounds and other preschool institutions receive them between three and eight. The Unified Labor School, either seven or nine years, completes general social education, in the first grade (8-12) and in the second grade (12-15 or 17). The second grade is divided into two cycles, the first of three years and the second of two. The second cycle offers a rather specialized training, suited generally to the local industries. In the second grade are taught social science, the mother tongue, mathematics, natural science, chemistry, physics, geography, foreign language, labor education, art, music and care of the body. Both nurseries and kindergartens are still far from adequate to meet the needs of the respective age groups; the same is true to a less extent of the Labor schools. Hearths and kindergartens in 1928-29 numbered 2,477 with 128,200 children; first grade Labor schools, 114,735, with about 9,000,000 in attendance; second grade Labor schools, 7,550, with 3,035,200 students. Not included in these figures were 691 schools for over-aged, 700 schools for peasant youth and 78 school communes.

Professional training is offered on three levels: (1) the lower trade schools and factory schools; (2) the middle *technicums*, receiving children usually about 15 and giving them three years' preparation in medicine, art, pedagogy, agriculture, industry and socio-economics; and (3) the universities and institutes, receiving students from the *technicum*, the nine-year Labor school and from the special workers' faculties that have been set up to give preparatory training to those workers who never had the opportunity of regular schooling. Beyond the universities exists a net of scientific research institutions connected sometimes with universities, with various industries, or enjoying an independent existence.

On the lower professional training level, there were in 1926-27, 1,249 "prof schools" with 119,260 pupils; factory schools, etc., 1,088, with 101,317 pupils; 233 trade schools with 11,932 students; and 1,535 institutions giving short professional courses to 156,682 students. Of *technicums* there were in 1928-29, 1,053, with an attendance of 207,600. At the same time there were 164 workers' faculties, with 52,900 stu-

dents. Higher professional education was offered in 128 institutions, of which 21 were universities, with a total student body of 167,100. An inheritance of illiteracy, about 70 per cent, from the old regime and the necessity of inculcating a new ideology in adults as well as in the rising generation, forced the creation of a vast system of political training which begins with "liquidation points" for wiping out illiteracy; and schools, slightly more advanced, for the "little literate." From these one may advance, on the one hand, to elementary and advanced courses for general education and thence to the workers' faculty and the university; and, on the other, to "schools of political literacy," first grade Soviet Party schools, second grade Party schools and finally to the Communist universities. Of Party schools, 1928-29, there were 587 with 43,400 students; and of Communist universities, 18, with 7,800 in attendance.

Extra-Scholastic Agencies. The educational importance of extra-scholastic agencies is very great. Probably more has been done by the Soviet Union to utilize these agencies of mass propaganda than any other state in the world. The army and fleet with their thousands of schools and libraries are a training center whence youth go back to the village as missionaries of the Red Dawn. Upwards of a thousand museums are utilized every day by visiting groups who listen to special guides. Besides these there are nearly 30,000 libraries, and many other thousands of reading rooms; 7,000 clubs; nearly 10,000 self-instruction circles; over 6,000 "peasants' houses"; 37,000 books and pamphlets a year (1928-29) and over 1,700 periodicals with a total circulation of 22,000,000 (1930); 1,000,000 peasant and worker correspondents; between 2,000-3,000 stages and 12,000 cinemas; and a radio system whose public loud speakers reached, it is estimated, 124,500,000 in 1928-29. All these agencies are being utilized in the stupendous cultural revolution, on the success of which the Soviet regime depends. Most powerful of the educational forces of the country are the Party and the children's political organizations. The latter, the Pioneers and Komso-mols, the supreme activists on whom the Party depends to lead without faltering in socialistic constructive work, thus setting an example to be emulated by unorganized children, now number approximately 7,000,000, and the Communist Party itself about 2,000,000 including candidates on probation. T. Wo.

BIBLIOGRAPHY—A. P. Pinkevitch, *The New Education in the Soviet Union*, 1929, Thomas Woody, *New Minds: New Men?*, N. Ognov, *The Diary of a Communist Schoolboy* and *The Diary of a Communist Undergraduate*, 1928; S. N. Harper, *Civic Training in Soviet Russia*, 1929; *Peoples' Education in the U.S.S.R.*, In Russian, 1929.

RUSSIAN LANGUAGE, the most important of the modern SLAVIC languages, spoken by some 80,000,000 people in European Russia and Siberia. Together with UKRAINIAN and WHITE RUSSIAN, it forms the East Slavic linguistic group, whose chief characteristics are 1. interconsonantal *olo, ele, oro, ere* arising from Proto-Slavic *ol, el, or, er* as contrasted with South Slavic *la, lě, ra, rě* and West Slavic *lo, le, ro, ře* (re),

e.g., Proto-Slavic *golva*, "head," Russian *golová*, Old Bulgarian *glava*, Polish *glowa*, 2. *č, ž* arising from *tj, dj* as contrasted with South Slavic *št* and West Slavic *č*, e.g., Proto-Slavic *světja*, "candle," Russian *svěčá*, Old Bulgarian *svěsta*, Polish *świeca*; 3. change of original nasalized *o* and *e* to *u* and *ja* respectively; 4. *o* initially instead of original *je*. The word-accent is free.

Russian has a large number of dialects, which, however, do not differ greatly. All can be classified either as *o*-dialects in the north or as *a*-dialects in the center, the former preserving original *o*, while the latter change it to *a* when unaccented. The basis of the modern Russian literary language is the Moscow dialect in the *a*-territory. The earliest document, though written in OLD CHURCH SLAVIC with only a few Russian characteristics, is the *Ostromir Gospel* of 1056-57, for by the end of the 10th century, when Vladimir, Grand Duke of Kiev, accepted Christianity, Church Slavic had become the literary language of the country, holding this position until the middle of the 18th century, when M. V. LOMONOSOV (1711-65) admitted some popular Russian into literature. The real founder of the present literary language, which even yet is not entirely free from the influence of Church Slavic, was N. M. KARAMZIN (1766-1826).

A. SE.

BIBLIOGRAPHY.—N. Forbes, *Russian Grammar*, 2nd ed., 1916; E. Prokosch, *Elementary Russian Grammar*, 1920; L. Marantz, *Russische Grammatik*, 6th ed., 1920; K. H. Meyer, *Historische Grammatik der russischen Sprache*, 1923.

RUSSIAN LITERATURE began with the Christianization of Russia from Byzantium in 988, but did not attain international importance until the 19th century. The fact that Russia accepted Christianity from the Eastern Church is of primary importance in its cultural development. With Christianity Russia received translations of the Gospels, the Liturgy and other texts in the Church Slavic language used by Cyril and Methodius, the first missionaries to the Slavs. This language is akin to Russian, but not identical with it, and it has remained the language of the Russian Church. Until about 1700 it was the language used, with an increasing admixture of Russian, by most Russian writers, and it has left strong traces on the present Russian literary language. The use of Church Slavic contributed in separating Russia from western Europe, which was bound into cultural unity by its adherence to the Catholic Church and to Latin as the language of learning. Feudalism and chivalry were unknown in Russia, and the country had no medieval literature based on them. One prose poem, *The Tale of Igor's Raid*, dating from about 1187, is the only text that can be compared with the heroic poetry of the west. Early Russian literature, which had its center in Kiev and was at its best in the 12th century, consists of translations of Greek homilies, saints' legends and apocryphal stories; of original compositions of a similar sort; and, most important, of chronicles. The chronicles, which continue to the 16th century, have spirit and vigor. Dur-

ing the Muscovite period of Russian history, c. 1300-1703, literature remained ecclesiastical, and, in general, the whole period was intellectually sterile. The political pamphlets of IVAN THE TERRIBLE (1530-84) show more personality than any other texts of the time. In the 17th century western ideas and literary forms began to penetrate into Russia through Poland.

Foreign Influence. Russia's active participation in modern European politics and culture dates only from the reign of Peter the Great (1689-1725). In order to improve his civil and military administration, Peter introduced foreign teachers into Russia and encouraged his nobles to travel abroad. With the creation of a cultivated nobility in St. Petersburg and Moscow, modern Russian literature began. During the 18th century the literary language was perfected. Writers now used the language of the people, although in the higher style the influence of Church Slavic remained prominent well into the 19th century. The new Russian literature developed under the influence of French models, then dominant throughout Europe. Lomonosov (1711-65), a peasant of genius, wrote pompous odes and didactic poetry, and with others laid the foundations of modern Russian prose. During the reign of Catherine II (1762-96), Russian authors were already somewhat more than imitators of foreign models. DERZHAVIN wrote lyric poetry in a less artificial style than Lomonosov. The comedies of von Visin still have vitality because of their satire of Russian obscurantism. But the two members of the French school whose work has remained important are of later date. The fables of Krylov (1768-1844), and the comedy, *Wit Works Woe*, by GRIBOYEDOV (1795-1829), continue to be popular today.

The romantic literature of Germany and England soon influenced Russia, where it gave rise to the Golden Age of Russian poetry. PUSHKIN (1799-1837), the greatest poet of Russia, is as equally eminent a lyric as a narrative poet. His *Eugene Onegin*, a novel in verse, is a masterpiece of Russian poetry. The ineffectual dandy, Onegin, and the strong, pure heroine, Tatyana, are the prototypes of numerous characters in later fiction. LERMONTOV, a less versatile poet, wrote under the influence of Byron; his prose romance, *A Hero of Our Time*, is among the best Russian novels.

The 19th Century. As the 19th century progressed, education spread rapidly in Russia and readers were more numerous. Russians became interested in questions concerning the relations between proprietors and serfs and the honest administration of the public service. Literature developed into an active force. Under despotism, open discussion of public questions was impossible, but such topics found their way into prose fiction, drama and literary criticism.

The romantic poets were succeeded by a school of realistic novelists and dramatists that is the greatest glory of Russian literature. Its members interpreted the national life with a truth to fact and imaginative insight and sympathy that have not been surpassed in the literature of any nation. Yet GOGOL (1809-52),

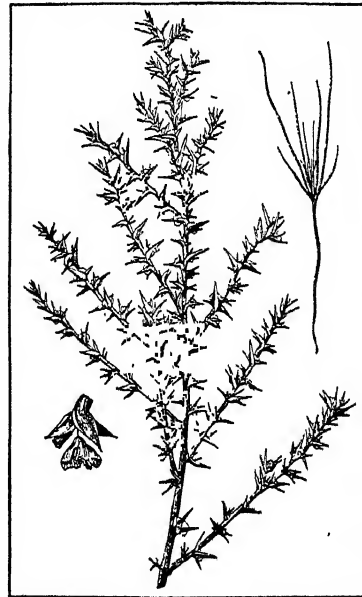
who is generally regarded as the founder of the school, is a satirist and caricaturist rather than a realist. In his *Inspector*, the best of Russian dramas, he gives a farcical picture of government graft; in *Dead Souls*, the story of a clever swindler and his adventures among the country gentry, he draws a superb series of grotesque portraits. Ostrovsky, the one professional dramatist of Russia, in numerous plays dealt with the middle classes, particularly the merchants. TURGENEV (1818-83), with his *Sportman's Sketches*, influenced public opinion in favor of the emancipation of the serfs. He wrote a series of novels, of which *Fathers and Children* is perhaps the most outstanding, on the life of the rural aristocracy. Delicacy and restraint characterize Turgenev's work; he is the novelist of youthful love and the tragedy of its non-fulfilment. In his own time, his fame depended as much on his skill in describing currents of social thought as on his sharply etched portraits of individuals. GONCHAROV (1812-91), in his novels, *Obломov* and *The Precipice*, portrayed the sleepy gentry of the Russian countryside; his hero Obломov became the type representing the national inertia.

LEO TOLSTOY (1828-1910), greatest of all Russian authors, in *Sevastopol* drew bitter pictures of military life. For the first time in fiction, he centered attention on the horrors rather than the glories of war. In his *War and Peace* and *Anna Karenina* a multitude of men and women live, love, struggle, grow old and die. The inclusive veracity of the picture and the impartial sympathy of the artist are unsurpassed in western fiction. In 1878, Tolstoy underwent a religious conversion that led him to devote himself for some years to writings in which he developed a system of Christian anarchy, based on non-resistance to evil. His *My Religion, What Shall We Do Then?* and *The Kingdom of God Is Within You* have had wide circulation and have contributed not a little to the pacifist and humanitarian movements. Returning to fiction, Tolstoy wrote in a strongly moralistic vein; of this period the novels, *The Death of Ivan Ilyich*; *The Kreutzer Sonata* and *Resurrection*, and the drama *The Power of Darkness* (the best of Russian tragedies) are his most famous works. In contrast to Tolstoy, Goncharov and Turgenev, who described landed proprietors and peasants, DOSTOYEVSKY (1821-81) wrote of city life. His great novels, *Crime and Punishment* and *The Brothers Karamazov*, excel above all in psychological analysis. Dostoyevsky's insight into abnormal psychology has been verified by later scientific research. During the present century, his fame has reached far wider than it did in his own lifetime. A group of critics, whose work is of a more sociological than literary nature, accompanied the novelists. Even the greatest poet of the period, Nekrasov (1821-77), was in a measure a publicist. A feature of the time was the idealization of the Russian peasantry; students of folklore revealed a wealth of Russian popular ballads, folk tales, and ceremonial songs.

Modern Literature. After 1880, with the decline of the landed aristocracy and the rise of industry in

Russia, a change came over Russian literature. CHEKHOV (1860-1904), the great master of the short story and the best of recent dramatists, dealt with the declining gentry. GORKY struck a fresh note in Russian literature by treating of the new class of tramps, laborers and outcasts. Realism ceased to dominate Russian literature; symbolism and mysticism became prominent and a new poetry arose. Blok, the leader of the symbolist school, was the greatest Russian poet since the death of Lermontov. Merezhkovsky, in his historical fiction, embodied a semi-religious theory of human progress. ANDREYEV alternated between lurid realism and crude symbolism in his stories and dramas. Futurist poets strove to sweep away the old poetic diction and to write poetry in the jargon of the streets. After the Bolshevik revolution of 1917 their leader, Mayakovsky, became a prophet of the new order, celebrating the triumph of the proletariat in his fantastic drama, *Mystery-Bouffe*. Since the revolution no literary leaders of commanding genius have developed. But most notable, perhaps, is ESENIN (1895-1925), the best of a group of peasant poets. A school of proletarian poets chants crudely ecstatic hymns in praise of the factory. The characteristic feature of the new era is the flooding of literature with Communistic propaganda. G. R. N.

BIBLIOGRAPHY.—P. Kropotkin, *Russian Literature*, 1905, A. Bruckner, *A Literary History of Russia*, 1908, D. S. Mirsky, *Contemporary Russian Literature (1881-1925)*, 1926, and *A History of Russian Literature (to 1881)*, 1927.



COURTESY IOWA GEOL. SURV.

RUSSIAN THISTLE

Upper portion of stem, single flower (left), and seedling (right)

RUSSIAN THISTLE (*Salsola Kali* var. *tenuifolia*), a smooth, prickly, annual herb of the goose-foot family called also Russian cactus. It is native to Europe and Asia and very widely naturalized in North America. In several western states and in the

Canadian Northwest it is an exceedingly pestiferous weed, especially in grain fields. The bushy branched stems, usually 1 to 2 ft. high, bear narrow, rigid, awl-pointed leaves, which together with the outer branches commonly become bright red at maturity. In the axils of the leaves are borne very numerous inconspicuous flowers and small winged seeds. When dry in autumn the entire plant is blown about as a tumbleweed, widely disseminating its seeds.

RUSSO-JAPANESE WAR, the conflict of 1904-5 caused by the clash between Japan and Russia in their efforts to expand their respective interests in Manchuria. Russia, under agreement with China, had built a railway across northern Manchuria connecting with the Trans-Siberian line to Vladivostok, and a branch of this line southward to the Liaotung Peninsula, and had secured a lease on the end of the Liaotung Peninsula which gave her the two important ice-free ports of Dairen (Dalny) and Port Arthur. She had developed Port Arthur as a naval base, and Dairen as a commercial center. Russia also was pushing her influence into Korea. Japan sought access to the important mineral resources in Manchuria, and was seriously concerned over the threat to her independence which the Russian expansion into Korea created. After prolonged negotiations, in which the Japanese attempted to secure from Russia a pledge not to expand further, the Japanese finally decided to fight out the issue. Friendly relations were broken off Feb. 15, 1904. In 1902 Japan had secured an alliance with Great Britain by the terms of which Britain agreed to side with Japan in any war in case Japan became involved with more than one other nation. This alliance served to keep France out of the conflict.

Japan was well prepared, with 270,000 trained troops and 76 warships. Russia had something like the same number of men in Siberia and Manchuria, but had only 57 naval vessels in the Far Eastern waters. The fact that the only means of communication between European Russia and Manchuria was a single track railway 6,000 miles long, very materially handicapped Russia in carrying on the war.

Japan rapidly gained supremacy at sea. On Feb. 8, 1904, the Japanese navy wiped out the Russian squadron at Port Arthur, and on Aug. 14 destroyed the Russian warships from Vladivostok. The Japanese troops moved into Manchuria from Korea, and from landings in the Liaotung Peninsula. These latter forces cut off Port Arthur from the rest of Manchuria, and after a protracted siege in which there was heavy loss of life on both sides, Port Arthur was finally conquered in Jan. 1905. The Japanese troops then moved on northward toward Mukden where a decisive battle was fought beginning Feb. 21, 1905. Mukden was taken on Mar. 10, and the Russian resistance collapsed. The Russian Baltic fleet reached Manchurian waters early in May, 1905, and were met by the Japanese fleet and destroyed May 27 in the battle of Tsushima Straits.

In June, President Roosevelt of the United States

proposed that peace be made. This proposal was accepted. The delegates of the two countries met at Portsmouth, New Hampshire, and the Peace Treaty was signed on Aug. 23, 1905. The Japanese loss of life had been very heavy during the war—the deaths totaled close to 300,000—and the economic resources of the country as well as Japanese credit abroad had been strained to the uttermost to meet the war costs. When peace was proposed Japan was almost completely exhausted. Russia also was not in a position to carry on the fighting. The peace treaty gave Japan a foothold in South Manchuria, insured cessation of Russian penetration into Korea, and brought about the withdrawal of Russian military occupation of North Manchuria. See PORTSMOUTH, TREATY OF PEACE OF.

BIBLIOGRAPHY.—A. S. Hershey, *The International Law and Diplomacy of the Russo-Japanese War*, 1906, contemporary newspapers and magazines for the years 1904, 1905 and 1906.

RUSSO-TURKISH WARS, the conflicts of 1828, 1853-56 and 1877-78, by which Russia aspired to extend her influence over Constantinople. Although this Russian objective was not supported by the other great powers, and was earnestly opposed by Great Britain, all of the continent concurred in the wish to expel the Turks from Europe, on both political and religious grounds. Restricted warfare between Russia and Turkey had occurred in 1678-82, 1686, 1710, 1736-39, 1768-73, 1787-92, 1806 and 1809-11. Warfare on modern lines between the Russians and the Turks first began in October, 1827, when the allied Russian, English and French fleets vanquished the Turkish navy at Navarino, Greece. In April of the following year a Russian army attempted an invasion by way of Bulgaria. The Russians captured Adrianople Aug. 20, 1828, and by the treaty of that name, signed Sept. 14, 1829, Russia obtained all the eastern coast of the Black Sea, free navigation through the Straits of Bosphorus, and the Turks were forced to relinquish all hold upon Greece. The CRIMEAN WAR, 1853-56, began as a Russo-Turkish conflict, but was soon widened through the entrance of France and England into the struggle to oppose the Russian advance in the eastern Mediterranean. The third major Russo-Turkish War began on Apr. 24, 1877, when Russia declared war on her ancient enemy, whose subjects the year before had shocked Europe by massacring 12,000 Bulgarians. The Russian forces, supported by a navy of 13 ironclads, and by frigates and monitors, gradually forced Turkish submission, and in Jan. 1878, the Sultan made peace proposals. The war was concluded by the TREATY OF SAN STEFANO. But this treaty was not acceptable to England and Austria and was entirely revised by the Congress of Berlin.

RUST. The rusts are basidiomycetous fungi belonging in the order *Uredinales*. They are parasitic on ferns and seed plants, and have never been cultivated except on living tissues. They produce spores of five different kinds the basidiospores, the pycniospores, the aeciospores, the urediniospores and the

teliospores. One or more of the five kinds of spores are absent in many rust genera. The aecial stage usually occurs early in the spring and is, therefore, called the spring stage. The uredinal stage lasts through much of the summer and is the one which generally causes the most injury. In this form which is frequently referred to as the summer stage many rusts multiply and spread rapidly. The telial or winter stage is the resting stage. Classification is based largely on the teliospores.

There are more than 2,000 species of rust fungi. They are of world distribution and cause some of the most important diseases of economic plants. The cereal rusts, the apple rusts and the pine rusts are examples of species which cause heavy losses. One of the most interesting characteristics shown by certain of the rusts is the phenomenon of heteroecism. One stage of the fungus lives on one species of host plant, while another stage lives on a different host species. It frequently happens that the spores produced on one or both of these hosts are unable to cause infection or to spread the fungus to healthy plants of the species on which they occur. For example, the aeciospores produced on apple leaves by the apple rust are incapable of infecting apple leaves. They spread the fungus to species of *Juniperus*. The basidiospores produced on species of *Juniperus* by the same fungus are incapable of infecting healthy Juniper trees. They spread the fungus to apple trees. If it is to spread at all it must have both apple and Juniper trees on which to live and these trees must be located close enough together to permit spores to be blown from one to the other. If either tree is lacking the fungus can not complete its life cycle, can not spread, and, therefore, can not cause serious damage to either apple or Juniper trees. It is thus possible to control the apple rust in any region by the destruction of the Juniper trees in that region. Resistant varieties of host plants offer another method of control. Fungicidal dusts also have been used experimentally for the control of some of the cereal rusts.

L. O. K.

RUST. See CORROSION.

RUSTICATION, a form of stone ashlar masonry in which the edges of the stones are cut carefully to a common plane, but the area between the edges



RUSTICATION, PORTA DEL PALIO, VERONA, ITALY

is allowed to project outwards. In the form sometimes known as drafted masonry, the stone surface between the joints is left roughly axed or quarry faced. In more formal rustication the raised portions are carefully cut, forming projecting bands or panels. Sometimes the edges of the high portion are curved, sometimes splayed, sometimes cut sharply back at a right angle, and there is often a great difference in texture between the raised portions and the edges cut back to the wall plane. Rusticated masonry was used sparingly in Greek work for founda-

tion walls, much more frequently by the Romans, as in the Porta Maggiore, Rome, 1st century, and was developed into a major decorative element by the Renaissance architects, in strong and heavy, or light and delicate variations.

RUST UNIVERSITY, at Holly Springs, Miss., founded in 1872, is a coeducational Negro institution affiliated with the Methodist Episcopal Church. It is named in honor of Dr. Richard S. Rust, an aggressive advocate of Negro education who was influential in its establishment. The university emphasizes both literary and industrial education in its preparatory and college departments. The buildings were valued in 1931 at \$425,000, and there were 6,700 volumes in the library. In 1927-28 there were 262 students and a faculty of nine, headed by Pres. L. M. McCoy.

RUTABAGA, a coarse variety of TURNIP, called also swede or Swedish turnip, with a very large yellow root, extensively grown, especially in northern Europe, as a food for livestock.

RUTGERS UNIVERSITY, a university for men, situated at New Brunswick, N.J. It was founded in 1766 as Queen's College, renamed Rutgers College in 1825, designated the State University of New Jersey in 1917, and in 1924 renamed Rutgers University. Queen's College was established with funds collected in Holland by Theodorus Frelinghuysen. Rutgers University now includes a College of Arts and Sciences, College of Engineering, College of Agriculture, School of Education, School of Chemistry, Department of Ceramics, New Jersey College of Pharmacy, Graduate Courses, Summer Session, and University Extension. Affiliated with the university is the NEW JERSEY COLLEGE FOR WOMEN. The productive funds in 1931 amounted to \$4,143,485. The library contained 189,099 volumes. In 1930-31 Rutgers enrolled 15,182 students, counting summer school and extension courses. The faculty numbered 346 members. Robert C. Clothier became president of Rutgers in 1932.

RUTH, GEORGE HERMAN (1894-), baseball player, nationally known as "Babe," was born at Baltimore, Md., Feb. 7, 1894. He began his professional career in 1914 with the Baltimore International League Club, and then played with the Boston Red Sox. In 1920 he was sold to the New York American League Club for a sum said to be \$150,000, at that time the largest amount which had ever been paid for a player. Ruth's baseball fame rests on his remarkable batting ability, and because of his heavy hitting he gave up pitching and became an outfielder. In 1921 he made 59 home runs and bettered this record by one in 1927. He led the American League in 1924 with a batting average of .378. In 1930 Ruth signed a contract with the New York Yankees at a salary reported to be \$80,000. In 1928 he made 54 home runs, in 1929, 46, in 1930, 49, in 1931, 46, and in 1932, 41. His batting average for 1932 was .342.

RUTH, BOOK OF, in the Old Testament, is the idyllic story of a Moabitess, who with Naomi. her

mother-in-law, went to Bethlehem of Judea, married Boaz and became an ancestress of David. The book is often suspected by scholars as a piece of propaganda literature. It is a simply told story, picturing the life of God-fearing folk in ancient Israel. The attachment of Ruth to Naomi, expressed in words now so familiar, "Whither thou goest, I will go, . . . thy people shall be my people," and the happy issue of their troubles, illustrate the normal life of an age which had become idealized. The book is believed by many to date from a period after the death of David, but long prior to the exile; but some scholars believe it to be post-exilic. In confirmation of this position, they point out that the God of the Book of Ruth is the God of the whole earth, and akin to the God of the Book of Jonah, which might indicate that the two books had a similar motive of universalism.

RUTHENIA, SUBCARPATHIAN (Czech *Podkarpatská Rus*), an autonomous province of Czechoslovakia, Hungarian until 1918; the capital is UZHOROD. With an area of 4,864 sq. mi., it is bounded by Poland on the north, Rumania on the east, Hungary on the south and Slovakia on the west. Subcarpathian Ruthenia embraces that part of the Carpathian Mountains drained by the Theiss, as well as part of the fertile Hungarian plain. The climate of the mountain districts is raw and moist and the plain has cold winters and hot summers. Agriculture is the chief occupation. Wheat, corn and sugarbeets flourish on the plain; and the beechwoods on the mountains make forestry an important industry. Salt is present in the mountains and there is some oil. The manufactures are small and are confined to wood alcohol, lumber and matches. Of the population approximately $\frac{2}{3}$ are Ruthenians, living in the mountains, $\frac{1}{6}$ Magyars living on the plain, $\frac{1}{8}$ native Jews, $\frac{1}{30}$ Czechoslovaks; there are also a few Germans, Rumanians, Poles and others. Fifty-four per cent are Greek and Armenian Catholics, 10% Greek Orthodox, 9% Roman Catholics, 10% Protestants, 15% Jews. Though there are many schools, 77% of the Ruthenians and 50% of the total population are illiterate although the government is overcoming illiteracy. The province is primitive with a strong east European character. Pop. 1930, 725,350.

RUTHENIUM, a chemical element belonging to the platinum metals, was discovered by Osann in 1828. Its chemical symbol is Ru, its atomic weight 101.7; as a metal it is similar to platinum in appearance. A complex ammonium salt forms an excellent red dye, but is as yet very little used on account of its prohibitive cost.

RUTHERFORD, SIR ERNEST (1871-), British chemist and physicist, was born at Nelson, New Zealand, Aug. 30, 1871. He studied at the University of New Zealand, and at the Cavendish Laboratory in Cambridge, where, after having filled positions at the McGill and Manchester universities, he became professor of experimental physics in 1919. His classical researches upon the properties of radioactive substances and subsequent theory of radioactivity earned

for him the Nobel prize in chemistry in 1908, while, in addition, he has made notable contributions to the problems of the structure of the atom, and the electrical nature of matter. He has been the recipient of many British and international honors, among them the order of merit, awarded in 1925.

RUTHERFORD, a borough of Bergen Co., N.J., located on the east side of the Passaic River, 9 mi. west of New York City and 6 mi. north of Newark. Its transportation facilities include the Erie Railroad and motor bus lines. It is a residential community, most of the local industrial establishments being located in the borough of East Rutherford which adjoins it to the north. The retail trade in 1929 amounted to \$8,195,936. It is a popular suburb for New York and Newark business men. Pop. 1920, 9,497; 1930, 14,915.

RUTHVEN, ALEXANDER GRANT (1882-), American zoologist and educator, was born at Hull, Ia., Apr. 1, 1882. He was graduated from Morning-side College, 1903, and from the University of Michigan in 1906. After 1906 he was a member of the faculty of the University of Michigan as instructor, professor and chairman of the department of zoology; curator and director of the museum of zoology; director of university museums; dean of administration, and in 1929 became president of the university. He has directed various scientific expeditions in North, South and Central America.

RUTILE, a brownish red mineral with a brilliant luster. Frequently the color is black, due to iron. It is opaque to transparent, the latter forms sometimes being cut as semi-precious stones. Rutile occurs in granites, schists, gneisses, and sometimes limestone and sands, as an ACCESSORY MINERAL. It crystallizes in the TETRAGONAL SYSTEM and chemically is titanium oxide. Norway, Sweden, Russia, Switzerland, France and the United States contain good occurrences of rutile. See also GEM STONES; MINERALOGY.

RUTLAND, a city and the county seat of Rutland Co., Vt., 90 mi. northeast of Albany, N.Y., on Otter Creek. It is a beautiful Green Mountain resort and is served by the Delaware and Hudson and the Rutland railways and motor buses. Dairying and truck-gardening are the chief agricultural interests of the vicinity. The city has marble works, noted throughout the country, stone cutting establishments and factories making scales, clothing, candy, awnings and maple sugar. In 1929 the manufactures reached approximately \$6,000,000; the retail trade amounted to \$13,753,602. The Long Trail, a foot-path extending from Massachusetts to Canada, with cabin shelters for hikers, passes through Rutland. Settled about 1761, Rutland was a state capital from 1769 until 1804; the village was incorporated in 1847; the city chartered in 1892. Pop. 1920, 14,954; 1930, 17,315; 10% foreign-born.

RUTLAND BEAUTY, a name given to a handsome garden variety of the bracted BINDWEED (*Convolvulus sepium*) with large white, rose-colored or pink flowers marked with whitish stripes.

RUWENZORI, a mountain range between lakes Edward and Albert, partly in Uganda and partly in the Belgian Congo. Here in the center of Africa, on the equator, is a snow-clad range with one peak, Mt. Margherita, rising to 16,815 ft. and forming a complete barrier against railroad communication between lakes Edward and Albert. To the west of the range lie the vast Ituri forest and the Semliki river joining the two lakes. To the east and southeast part of the headwaters of the Nile have their source and drain towards Lake Victoria.

The Ruwenzori range has been identified by some with the Mountains of the Moon of Ptolemy, the geographer. It was seen by Baker in 1871 and Stanley in 1888. The Duke of Abruzzi climbed the highest peaks in 1906, and named the Margherita and the Alexandra (16,744 ft.).

RUYSDAEL, JACOB VAN (c. 1628-82), Dutch landscape painter, was born at Haarlem, about 1628. He painted sea- and landscapes, coast and forest scenes, and his canvases are carefully composed, sensitive in feeling and skilful in technique. According to Reinach, "he is the greatest landscape-painter of Holland . . . no painter has put more of his own soul into Nature." His masterpiece, *The Marsh*, is at Leningrad, the painter is well-represented at The Hague, Amsterdam, Dresden and Berlin; the Metropolitan Museum, New York, has his *Wheatfields and Landscape*. Ruysdael's work met with little recognition during his life and he died in the Haarlem almshouse, Mar. 14, 1682.

RUYTER, MICHAEL ANDRIANSZON DE. See DE RUYTER.

RYAN, JOHN DENIS (1864-), American capitalist, was born Oct. 10, 1864, at Hancock, Mich. He went West in 1889 and by 1904 had attained the position of manager of the Amalgamated Copper Company in Montana. In 1905 he was made president of the Anaconda Copper and Mining Company and in another three years was the head of the Amalgamated. A merger of the two companies was effected in 1910 and Ryan remained president until 1918. In that year, President Wilson appointed him director of aircraft production, chairman of the aircraft board, second assistant secretary of war and director of air service, but he resigned from government service after a few months. He was made chairman of the Anaconda Copper Mining Company in 1919. He has held many positions of director and chairman in industrial and banking concerns.

RYAN, PATRICK JOHN (1831-1911), Catholic archbishop, was born near Thurles, Ireland, Feb. 20, 1831. His education was commenced at St. Patrick's College, Carlow, Ireland, and completed at St. Louis, Mo., a year after his arrival in the United States. He first served as instructor in the diocesan seminary at Carondelet, and in 1872 he was chosen coadjutor bishop of St. Louis, becoming archbishop in 1884. Later that year he was transferred to Philadelphia. His interest in the Indians and Negroes led to his building two churches for the latter, and caused Presi-

dent Roosevelt to appoint him to the U.S. Indian Commission. His most popular book was *What Catholics Do Not Believe*, based on lectures given in 1877. He died at Philadelphia, Feb. 11, 1911.

RYAN, THOMAS FORTUNE (1851-1928), American financier and capitalist, was born in Nelson Co., Va., Oct. 17, 1851. His first job was a clerkship in a Baltimore drygoods store. He went to New York in 1870, and a series of successful deals enabled him to buy a Stock Exchange seat in 1874. With William C. Whitney he began operations in street-railway stocks and public utilities, and made a large fortune. He had controlling interests in railway and coal properties, owned shares in mining projects in the Belgian Congo, and dominated the domestic tobacco market. He is commonly credited with having averted a financial panic in 1905 by transferring his control of the Equitable Life Insurance Society to J. P. Morgan & Company. Ryan was a generous supporter of the Democratic party, and gave large sums to Roman Catholic and other charities. He died at New York City, Nov. 23, 1928.

RYAZAN, an important city in the Moscow Region of the R.S.F.S.R. It is situated southeast of Moscow, in central Russia, and is very picturesque, with numerous garden-clad hills and low plains. The city was founded in the late 11th century. Interesting features of Ryazan are the old Bazaar Place and the Kremlin, which incloses monasteries and Prince Oleg's Palace, now one of the Soviet Union's best district museums. Good roads and railway service, in addition to the Lybed and Trubezh rivers which are open for shipping, make Ryazan a trading center of some importance. It ships out poultry, eggs and farm produce, and the bricks, machinery and leather goods which it manufactures. Pop. 1926, 50,919.

RYBINSK, administrative center and inland port of the Rybinsk district of the Ivanovo Industrial Region of the R.S.F.S.R. It is situated on the banks of the Volga and Tcheremukha rivers, opposite the mouth of the Sheksna. Rybinsk is a leading Russian grain center, and from its harbor cereals, oil and other products are transhipped for Leningrad. Flour and lumber mills contribute to the city's prosperity. Rybinsk dates from the early 16th century, and has long been a trading port and ship-repair center. The local cathedral and art and history museum are of interest. Pop. 1926, 55,546.

RYDAL MOUNT, the home of the poet WILLIAM WORDSWORTH from 1813 till his death in 1850, situated at Rydal, Westmoreland, England.

RYDBERG, ABRAHAM VILTOR (1828-95), Swedish poet and novelist, was born at Jonkoping, Dec. 28, 1828. He was the author of several historical novels, *The Last Athenian*, *The Armorer*, and of reflective poems in the style of Goethe. He translated Faust into Swedish. Rydberg produced also many works on history and theology. He died at Ekeliden, Sept. 21, 1895.

RYDE, a municipal borough and resort located in the Isle of Wight, England, about 79 mi. southwest

of London. Until the 18th century it was an unimportant fishing village occupying the site of the village La Rye or La Riche destroyed in the 14th century. It is to-day much frequented in August and September when yachting is favored. Rail connections join Ryde with the rest of the island and are supplemented by boat traffic with towns on the mainland. Pop. 1931, 10,519.

RYDER, ALBERT PINKHAM (1847-1917), American painter, was born at New Bedford, Mass., Mar. 18, 1847. He studied under William E. Marshall and at the National Academy of Design, New York. Ryder specialized in romantic subjects, usually painting in somber colors. He was elected to the National Academy in 1906. His *Smuggler's Cove*, *The Bridge*, *Toilers of the Sea* and *Jonah* are in the Metropolitan Museum, New York. Other well-known paintings are *Death on a Pale Horse*, *The Pasture*, *The Curfew Hour* and *Pegasus*. Ryder died at Elmhurst, N.Y., Mar. 28, 1917.

RYDER, CHAUNCEY FOSTER (1868-), American painter, was born at Danbury, Conn., Feb. 29, 1868. He studied at the Art Institute, Chicago, and under Collin and Laurens in Paris. He located in New York and was elected to the National Academy in 1920. Ryder is represented in the Delgado Museum, New Orleans; Corcoran Gallery, Washington; Art Institute, Chicago; Engineer's Club, New York; Smithsonian Institute, Washington; Brooklyn Museum; and elsewhere in the United States, Canada, France and England.

RYE, an annual plant (*Secale cereale*) of the grass family unknown in the wild state but supposed to have been developed by man from a perennial mountain rye native to highlands in Mediterranean countries of Europe and eastward to Central Asia. As no rye has been found in the Middens of the Swiss Lake Dwellers (though wheat, barley and spelt have been), as Greek writers do not mention it and as Roman authors speak of it as a plant new to them though grown by the barbarians, it is presumed to have been cultivated for only about two thousand years.

It has been grown chiefly for its seed which is used as human and animal food and for making whiskey. The immature plant is also employed for stock feed either green or as hay and as a green manure, being plowed under preferably when less than a foot high and mixed with the soil. The straw from mature plants is used as bedding, and for mat and hat making.

As a crop, rye is of minor importance in comparison with wheat, barley, rice and corn which have almost wholly replaced it in the warmer climates of the world. It still holds a prominent place as a bread grain among northern peoples of Europe, but less in America except among descendants of these peoples. It is the leading cereal of Russia and Scandinavia, the former country producing about 25% of the world's supply. According to the U.S. Department of Agriculture the production of rye during 1900 was 31,000,000 bu.; in 1910, 35,000,000 bu.; in 1920, 60,000,000

bu., and in 1930, 50,234,000 bu. The chief producing states are North Dakota, Minnesota and Nebraska.

Like buckwheat, rye has been reputed to be a badge of poor farming. As it will make moderate development on soils too poor, light and thin for barley and wheat it has been mainly relegated to such soils, nevertheless it deserves better treatment as it will respond to liberal feeding and tillage as well as any other cereal. It thrives best on soils that contain less clay than the best wheat lands but good drainage is equally important, and so is the protection of snow during winter. The chief reason for growing it on ideal wheat soils is the high value of its straw. For this reason it is often more profitable to grow than wheat. On such lands it follows heavily manured corn and precedes oats fertilized with superphosphate and then grass and clover seeded (with rye as a "nurse crop") and fertilized with superphosphate, the grass being used for hay and pasture two or more years each before being plowed again for corn. By such rotation the nitrogen in the soil is rarely so great and the phosphate will be in adequate amount to prevent the rye from lodging.

The land is prepared as for wheat, which it resembles in having spring and winter varieties and like which it is sown. Its long straw, however, presents special difficulties in harvesting with ordinary grain reaping and binding machines which often clog and tie two bundles together. For this reason it is often cut with the self-rake reaper. Rye is threshed by flailing or by a beater, a special type of threshing machine which has corrugations instead of teeth and into which the bundles are fed parallel with the axis of the cylinder instead of perpendicular. After passing through it the machine binds the bundles of straw.

M. G. K.

Production and Trade. The United States ranks fifth among the principal rye producing countries of the world, with an annual production usually between 40 and 60 million bushels. Russia is the largest producer, growing from 650 to 850 million bushels each year; Germany ranks second, with 250 to 350 million bushels; Poland produces from 150 to 250 million bushels; and Czechoslovakia produces slightly more than the United States. There are about 3,500,000 acres planted in rye each year in the United States and the average yield per acre from 1921 to 1930 was 13.49 bushels. North Dakota is the largest rye producing state and is followed usually by Minnesota, Wisconsin, Nebraska, Indiana, Pennsylvania, North Carolina, Montana, Illinois and Wyoming. The chief marketing centers are Duluth, Minneapolis, Chicago, Milwaukee and Omaha. The total farm value of the rye produced in 1930 was about \$20,859,000.

In international trade the United States, Russia and Poland are the leading exporters of rye, and Germany, Denmark, Czechoslovakia, Norway and Finland, the largest importers. Between 1914 and 1927 the amount exported by the United States ranged between 26 and 76.7% of the total production, but in 1928 the percentage had dropped to 21.9 and, in 1930, to 6.2.

About one-half million bushels of the United States annual exports go to the United Kingdom.

RYE PRODUCTION, U.S.

7-Year Average, 1924-30

Division	Acreage (1,000 Ac.)	Production (1,000 Bu.)	% of Tot. Prod.
UNITED STATES	3,698	49,486	100 0
LEADING STATES:			
North Dakota	1,298	15,145	30 6
Minnesota	453	7,705	15 6
Wisconsin	232	3,630	7 3
Nebraska	252	3,450	7 0
Michigan	190	2,615	5 3
South Dakota	209	2,603	5 3

RYE, a village in Westchester Co., southeastern New York, situated on the north shore of Long Island Sound, 25 mi. northeast of New York. Rye is a residential suburb of New York City on the Boston Post Road, served by motor buses and two railroads. The village was founded in 1660; incorporated in 1904. The building used as the municipal offices was once "Haviland's Inn," said to have been visited by Washington, Lafayette and John Adams. The seaside playground under the control of the county is situated at Rye Beach. John Jay is buried at Rye. Pop. 1920, 5,308; 1930, 8,712.

RYE GRASS, the common name for a genus (*Lolium*) of Old World grasses, two of which are of agricultural importance. They are small annuals or perennials with usually erect unbranched stems, flat leaves and numerous flat, many-flowered spikelets in a somewhat zigzag raceme. The perennial or English rye grass (*L. perenne*), and the Italian rye grass (*L. multiflorum*), cultivated as meadow and pasture grasses, have run wild in North America, as has also the darnel or cheat (*L. temulentum*), a noxious weed which produces more or less poisonous seeds.

RYE HOUSE PLOT, a conspiracy against the life of Charles II. Following the failure of the Exclusion Bill to bar Charles's Catholic brother James from the throne, the conspiracy was arranged in 1683 by disaffected Protestants. The plot was discovered and a number of prominent persons executed.

RYKOV, ALEXEI IVANOVICH (1881-), Russian political leader, was born at Saratov in 1881. From an early age he was propagandist for the revolutionary movement and in 1905 became representative of the Bolshevik party in the St. Petersburg soviet. After the November Revolution in 1917 Rykov was for a short time President of the Supreme Economic Council and succeeded Lenin as President of the Council of the People's Commissars. In 1930 he was forced to resign as head of the People's Commissars and became Commissar for Posts and Telegraphs. He was elected to the important Central Executive Committee at the Sixth All-Union Soviet Congress on Mar. 16, 1931.

RYSWICK, TREATY OF, 1697, an agreement which brought to an end the War of the League of Augsburg between Louis XIV of France and the League, composed of The Netherlands, England, Spain, Sweden and several German states. Louis was bent on extending France's northern and eastern frontier at the Rhine, but his opponents were too powerful for him, and he had to surrender all territory annexed by him since 1678 except to allow the Dutch to garrison certain strongholds in the Spanish Netherlands as a "Barrier" against France, to grant the Dutch a favorable commercial treaty, to restore Lorraine to its Duke, and to recognize William of Orange as King of England. One of the chief reasons why Louis was anxious to sign such an unfavorable treaty was to ingratiate himself with Charles II of Spain and prepare the way for the succession of his grandson to the Spanish throne.

W
3451